

Protect what we need!

WAgriCo – active for water protection



WAgriCo

Water Resources Management in **Co**operation with **Ag**riculture



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I. Europe's commitment to water protection

LIFE-Environment and the European Water Framework Directive (EC WFD)

The European Union's **LIFE-Environment** assistance programme builds bridges. It helps the member states to implement European environmental legislation by means of practical solutions and on-site projects, with the aim of preserving and strengthening the natural basis for life.



One important item of European environmental legislation is the Water Framework Directive (EC WFD for short), which has been in force since December 2000. Its aim is to restore all European bodies of water to good status by the year 2015, and certainly not later than 2027. It applies to rivers, lakes, coastal waters and the entire groundwater.

Groundwater undergoes constant exchange with streams, rivers, lakes and the sea. Because it is so important, the EC WFD requires that it be conserved in adequate quality and quantity. In other words, anyone who conserves the groundwater is at the same time taking good care of a basis for nature and human life and also for all other waters.

Why is it so important to protect groundwater in particular?

Groundwater is indeed a body of water, even if we rarely see it. Its hidden flow in rock pores and cavities is an integral part of the natural water cycle. It provides us with Europe's biggest freshwater reserves. They are the main source of high-quality, clean drinking water, which makes us the envy of many around the world.

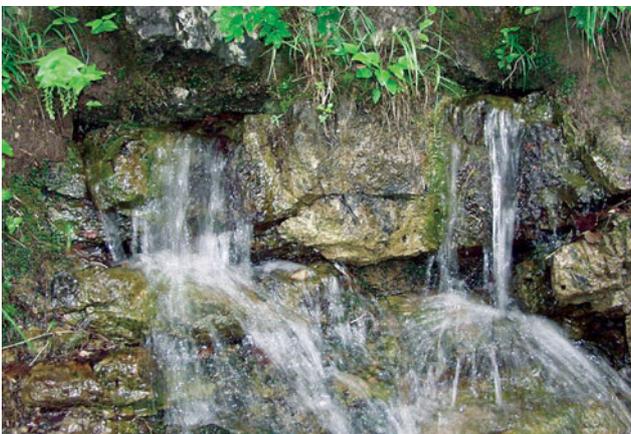
What does agriculture have to do with this?

Where there is intensive farming, there are usually large reserves of groundwater as well. There is a constant interchange between the arable land and the groundwater below it. And so Lower Saxony, with its thick glacial sediments, regular precipitation and permeable soils is at the same time the most important state in Germany for agriculture and groundwater.

The situation in the south of England is similar. High rainfall and shallow arable land give rise to large quantities of groundwater which, thanks to the jointed underlying rock, percolate through to the bedrock even faster than in Lower Saxony.

It is of course a good thing that adequate quantities of new groundwater form regularly in both countries. However, intensive farming can easily give rise to pollution of the groundwater despite compliance with all legal provisions. Nitrate and pesticides are a special source of concern. This is an area where the EC WFD now sets rigorous nationwide environmental objectives.

Good enough reason for Lower Saxony and the United Kingdom to join forces in the search for solutions. ■



Groundwater undergoes constant exchange with streams, rivers, lakes and the sea

II. WAgriCo in brief

A project with a lasting impact



In order to achieve the environmental objectives for water, all EU states are required to put forward suitable programmes of measures by the end of 2009. Implementation of these programmes will start in 2010.

One special challenge is to reduce nitrate pollution of the groundwater. This calls for active participation by farmers. It was for this reason that in 2005 Lower Saxony and the United Kingdom established the project "Water Resources Management in Cooperation with Agriculture", or WAgriCo for short.

The participants in both countries were the ministries and authorities responsible for the EC WFD, farmers and other experienced water conservation partners (consultants, research institutes, pressure group representatives). WAgriCo marked the start of a 3-year large-scale project for conserving groundwater. Its major components are:

- Participation of farmers.
- General improvement in acceptance of conservation measures.

- A basis for planning a targeted approach appropriate to needs.
- Effective measures for reducing pollution due to nitrates and pesticides and its transfer to agri-environmental programmes.
- Monitoring and assessment of the impacts and costs of measures.

The results and solutions should be ready for national and international implementation from 2010 onwards, but should also be capable of being applied ...

- locally** on individual farms,
- regionally** for larger target areas involving many farmers, and
- state-wide** to fulfil legal obligations to the EU.



Working together – farmers demonstrating practical water protection



Well prepared for the start

WAgriCo started in October 2005. It had the benefit of experience gained in long-term water conservation programmes and practical projects in Lower Saxony and the United Kingdom.

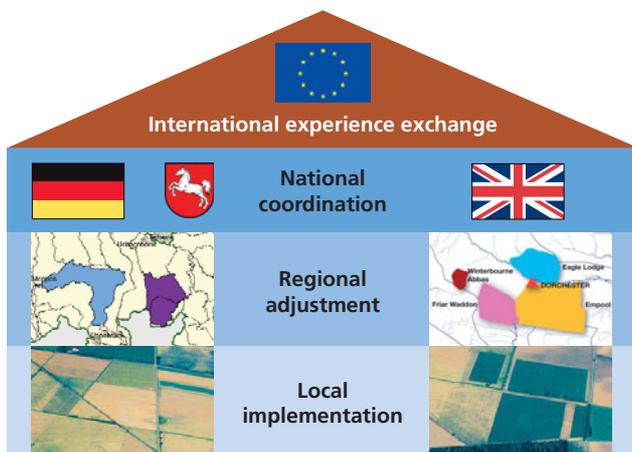
- From 1992 to the present day, the “Lower Saxony Cooperation Model for Drinking Water Protection” has achieved demonstrable improvements in groundwater quality in drinking water abstraction areas, especially as regards nitrate.
- In the United Kingdom there have been various programmes for reducing nitrate and pesticides in bodies of water, also since the 1990s.
- Numerous projects for agricultural water conservation have taken place in Germany and the UK.

The programmes in both countries have received great recognition. They are based on voluntary participation and cooperation. That is one particular reason why many farmers have taken part in measures – with measurable success.

All this knowledge and experience was brought together in WAgriCo.

Set up genuine participation

No other EU environmental directive calls for such great regional public involvement as the EC WFD. This is why,



WAgriCo demonstrated how regional cooperation panels for water protection could work together to implement the EC WFD in the future

for the past three years, farmers in WAgriCo have taken part on an equal footing in making important decisions, developing measures and implementing them themselves. They have been in constant contact with the participating authorities and research institutes. Furthermore, German and UK farmers have taken advantage of their participation in WAgriCo to present their ideas and concerns to the political arena.

Results and solutions

WAgriCo shows that ...

- effective groundwater protection measures are necessary to accompany intensive farming,
- calculation models can be used to identify areas where there is a great need for measures,
- good acceptance of measures is only possible where farmers participate,
- effective water conservation measures are possible despite intensive agricultural production,
- consultancy services considerably improve the acceptance and impact of measures,
- the effects of measures and their cost-benefit ratio can be estimated for large areas,
- effective dovetailing of national planning, regional action and local implementation is possible.

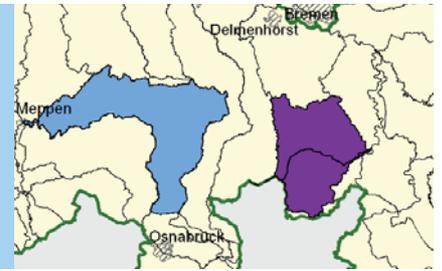
Thus gradual achievement of the environmental objectives of the EC WFD appears to be basically possible, though in some places it is not necessarily practicable because of very high costs.

But WAgriCo also shows that ...

- water policy and agricultural policy need to grow together at European and national level,
- it is essential to establish comprehensive and effective agri-environmental programmes for groundwater conservation that are adapted to current framework conditions,
- WAgriCo in Lower Saxony, for example, has already succeeded in transferring water conservation measures to a national agri-environmental programme starting in 2010.

III. Getting the scale right first time

Finding out where measures are necessary



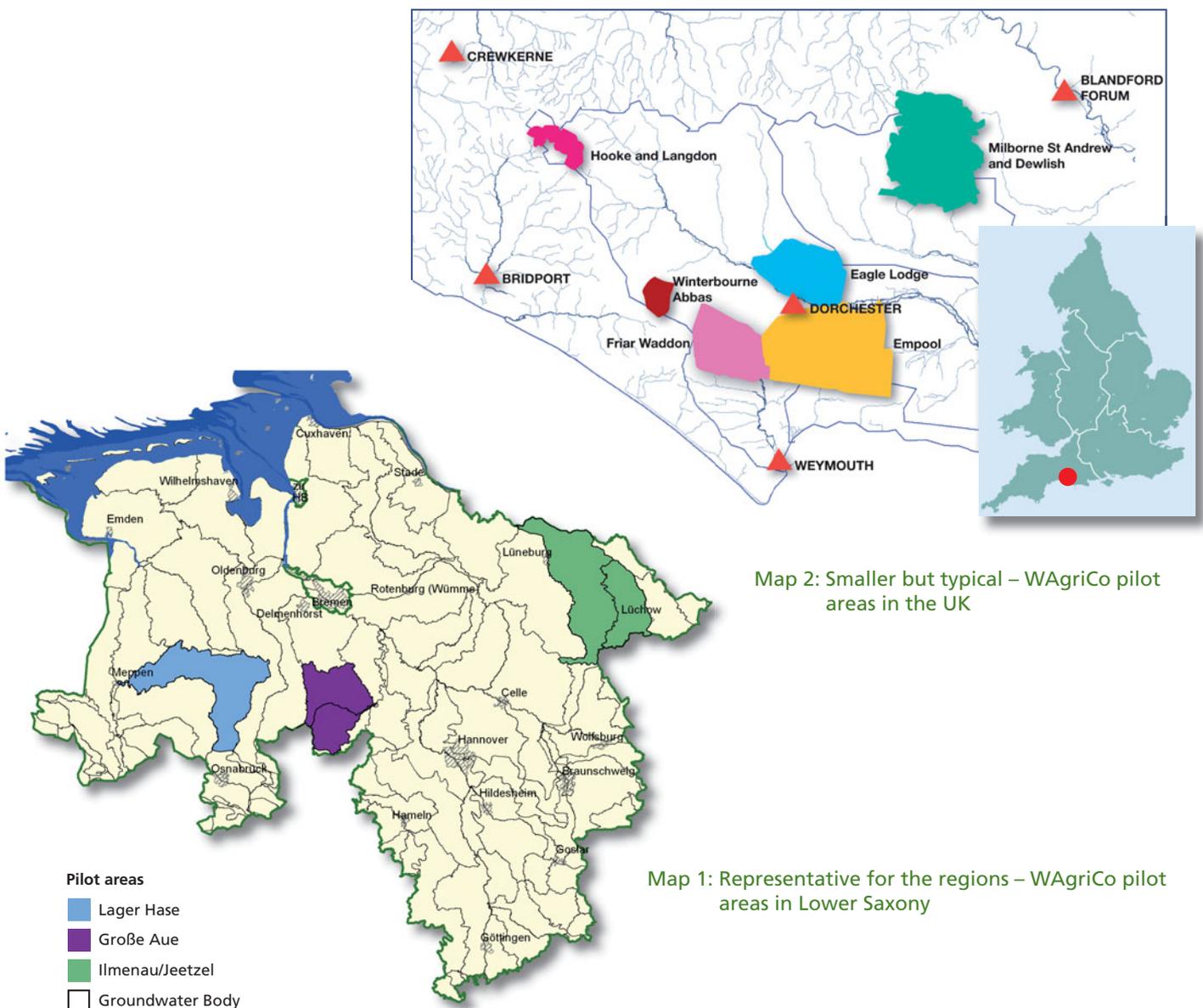
Suitable pilot areas selected

Groundwater exists almost everywhere, but the quality and quantity is not the same everywhere. For this reason, large groundwater areas are divided into smaller units for which the risks are assessed separately. From 2010 onwards, measures are to be taken to protect endangered groundwater resources in particular.

Lower Saxony subdivides its groundwater occurrences into "groundwater bodies", most of which have an area of several hundred square kilometres. This results in a total of 121 groundwater bodies.

WAgriCo has chosen its pilot areas on this scale (Map 1). They each comprise several groundwater bodies and a large area of agricultural land, and are distributed over the state on a representative basis.

In the United Kingdom, sensitive groundwater areas are grouped in larger areas. Here the opposite course was taken, selecting smaller but representative sections as WAgriCo pilot areas (Map 2).



Map 2: Smaller but typical – WAgriCo pilot areas in the UK

Map 1: Representative for the regions – WAgriCo pilot areas in Lower Saxony



Target areas instead of broad spread approach

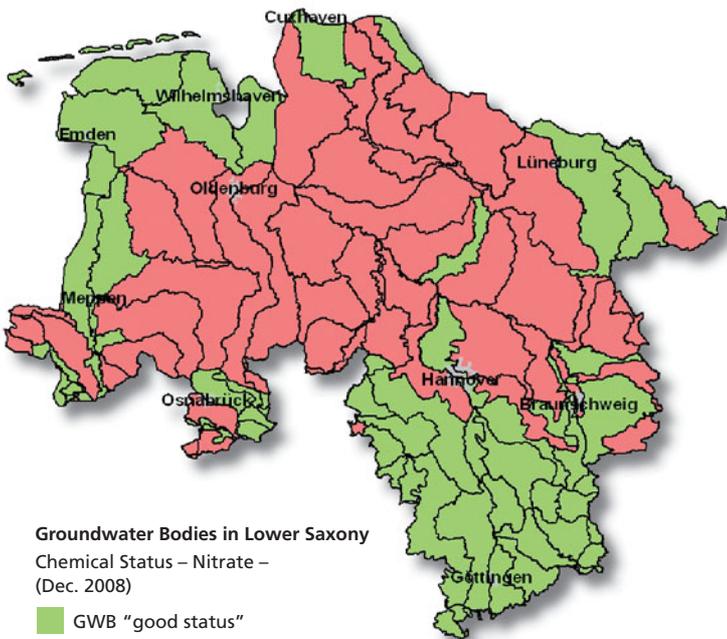
Not every area needs the same groundwater protection. Measures are necessary where pollution (e.g. nitrate) is highest.

To identify the critical areas in Lower Saxony, a state-wide evaluation of groundwater bodies according to the nitrate impact was done. The threshold limit of 50 mg nitrate per litre in the groundwater defined by law was exceeded within the red coloured areas (see Map 3).

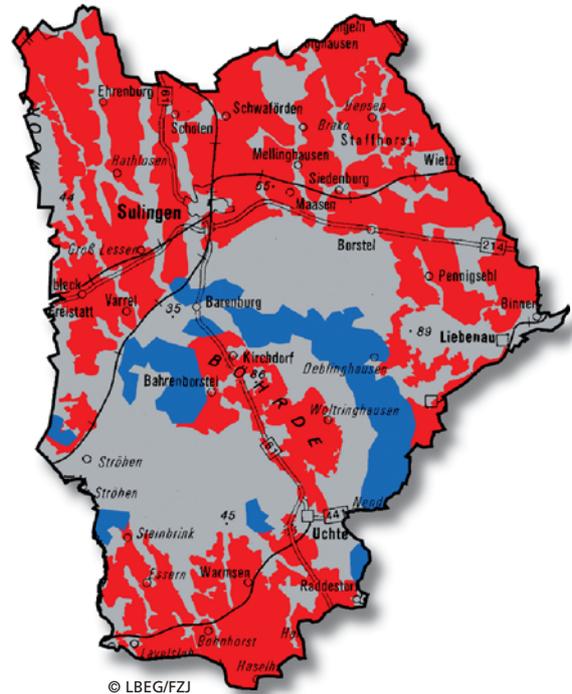
Because of long travel times, groundwater is decades or even centuries old and measures effects are delayed. Due to this delay groundwater monitoring is complemented by the nitrate concentration in the seepage water. Seepage water is the precursor of groundwater and therefore an "early warning system". A calculation model based on statistical data that are collected all four years, determines the nitrogen surpluses at agri-

cultural fields within each municipality. The "calculated nitrate concentration within seepage water" is based on the nitrogen surpluses and the water household. The mean nitrate concentration within seepage water below all kind of land use allows an early estimation of the nitrate impact on groundwater.

With this calculation approach actually target areas for groundwater protection measures are delineated on state level. In WAgriCo an additional technique has been applied to determine target areas for water protection measures. It distinguishes between target areas for groundwater protection (red) and target areas for surface waters (blue). Both are high sensitive areas (Map 4).



Map 3: Evaluation of groundwater bodies in Lower Saxony with regard to diffuse pollution (parameter nitrate)



Map 4: Target areas for measures within the pilot area Große Aue

IV. The journey from start to finish

Regional environmental objectives and reduction requirements



Mean nitrate levels in seepage water as yardstick

The European Union has defined the environmental objectives for groundwater in a complementary Daughter Directive of the EC WFD. Thus the threshold limit is 50 mg per litre in the groundwater. This is currently exceeded in many groundwater bodies in Central Europe.

The environmental objective in WAgriCo was to achieve a mean nitrate concentration of 50 mg per litre in the seepage water in cases where limit value infringements were found to occur in the groundwater itself within a groundwater body. The necessary reductions in agricultural nitrogen excesses were calculated for sub-units of the groundwater bodies.

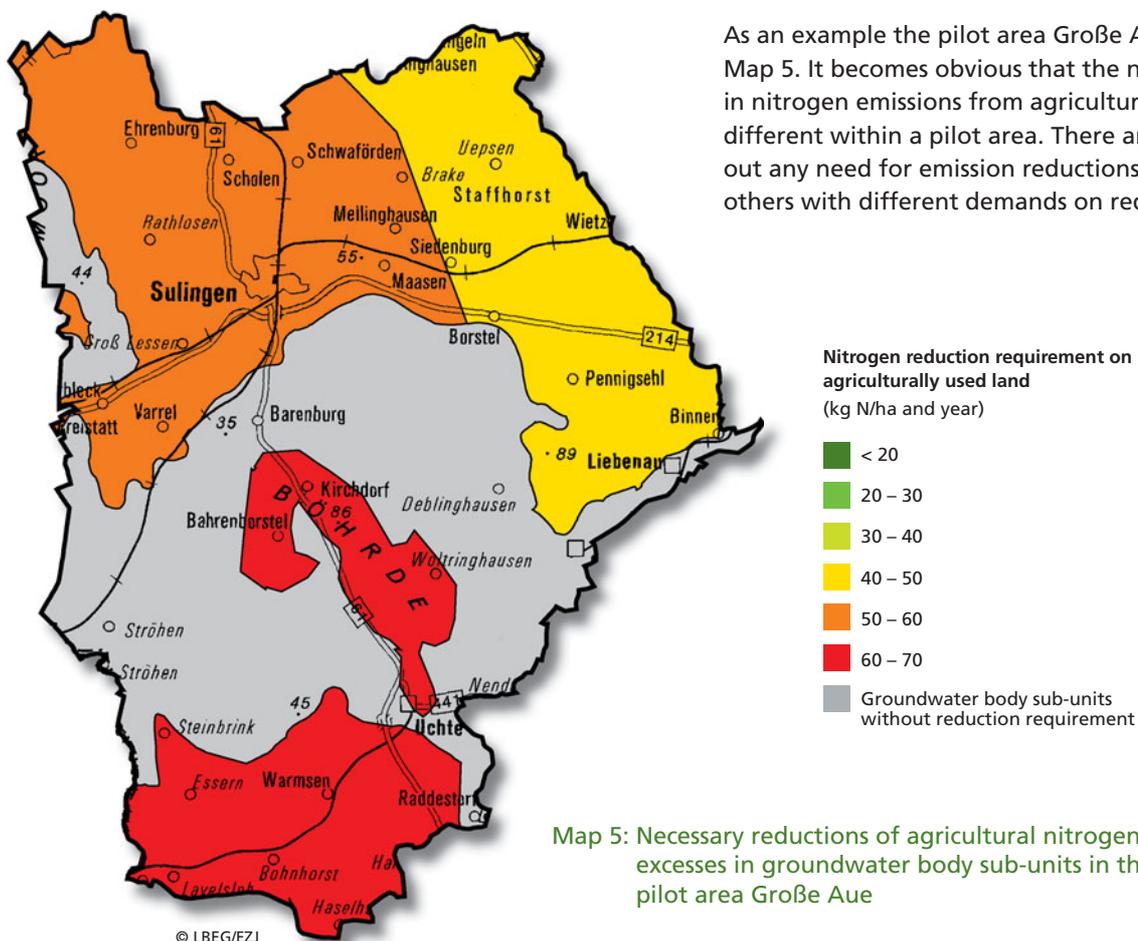
How much does the nitrogen excess in target areas need to be reduced?

As a rule, groundwater areas with large amounts of arable land and high livestock density exhibit the highest nitrate levels in seepage water. This is where the greatest need exists to reduce agricultural nitrogen excesses.

The necessary reductions in agricultural nitrogen excesses were determined for the entire state using a calculation model (Chapter III). The results show where large reductions are needed to achieve the environmental objectives of the EC WFD. This approach was also used for the WAgriCo pilot areas in order to ...

- define regional environmental objectives for individual areas
- and determine the necessary reduction in agricultural nitrogen excesses.

As an example the pilot area Große Aue is shown in Map 5. It becomes obvious that the need for reductions in nitrogen emissions from agriculture can be quite different within a pilot area. There are sub-areas without any need for emission reductions (grey areas) and others with different demands on reduction.



Map 5: Necessary reductions of agricultural nitrogen excesses in groundwater body sub-units in the pilot area Große Aue



V. Toolbox of appropriate measures

Improve nitrogen efficiency, avoid nitrate losses

Tools only successful in combination

The best way to protect the groundwater is to minimise inputs into the soil seepage water right from the start. This is precisely the aim of all WAgriCo measures. These include ...

- a **consultancy service for farmers** that is specially keyed to water conservation
- **farm-specific measures** to improve nutrient utilisation, e. g. accurate slurry application techniques
- **area-specific measures** to achieve a direct reduction in nitrate leaching, e. g. active greening and no tillage during wintertime

But this approach is only strong if the three elements are combined, because ...

- area-specific measures without advice often do not produce adequate results, and
- advice without area-specific measures is not enough on its own.

All the participants in WAgriCo agreed that consultancy service is definitely a necessary component.

Advice that results in clarity

A good water conservation consultancy service needs experienced personnel with expert knowledge of both the agricultural and water management sectors. In the WAgriCo pilot areas, such a consultancy service was used as a "driving force" for local implementation of water conservation measures.

The consultancy service ...

- offers information and explanations,
- creates acceptance through good moderation and technical competence,
- undertakes farm-specific analyses to save fertiliser and pesticides,
- plans, provides and looks after farm-specific and area-specific measures on-site,
- thereby supports the improvements in nitrogen efficiency on farm-level
- and looks after reviewing the progress of the measures.



Consultancy service practised face-to-face on the farm ...



... and in the field



Tried-and-tested measures that are effective

Improving nitrogen utilisation

Nitrogen fertilisers are expensive. Better fertiliser management can help save money, comply with fertiliser legislation and spare water resources. For example, the drinking water protection consultancy service has succeeded in reducing the nitrogen excess on many farms by 20 to 40 kg per hectare by providing intensive advice on fertilisers.

But WAgriCo has gone a step further. It has given farmers financial rewards if they improved their nitrogen fertiliser utilisation compared with previous years. How they did this was left to the decision of the farmers.

Direct reduction of nitrate and pesticide leaching

The area-specific measures used in WAgriCo for reducing leaching of nitrate into soil seepage water have proved their worth over the years. New aspects are ...

- their transfer to large areas (groundwater bodies),
- the fact that each measure is assigned a measurable ecological effect, in this case the annual leaching reduction in kg of nitrogen per hectare,
- that the cost-benefit ratio was calculated for each measure
- and that the measures are described in easily understood measure sheets.

The following is an overview of what has been implemented on pilot farms above and beyond statutory requirements:

“Storing nitrate through winter ...”



- **CATCH CROPS ...** sown in the early autumn after the grain harvest remove surplus nitrate from the soil, preserve it through the winter, do not pollute the seepage water, and then release the “rescued” nitrogen with a fertilising effect on the following crop.
- **MULTI-YEAR GREENING OF FALLOW LAND ...** provides similar protection, but over longer periods. It is much more expensive due to the loss of crops.

“Simply let it lie ...”



- **NO TILLING IN THE AUTUMN ...** inhibits nitrogen release from plant residues from the preceding crop and from the soil humus store.



“The optimum distribution of individual plants ...”



- CLOSE SOWING OF MAIZE ... results in better utilisation of nutrients and water in the soil, i.e. makes better use of the fertiliser applied.

“The optimum application of any kind of fertilizers ...”



- MINERAL FERTILISER DISTRIBUTORS or INJECTORS ... must be checked at frequent intervals for an exact distribution pattern, to ensure that the expensive fertiliser is distributed as evenly as possible.
- ACCURATE SLURRY APPLICATION with specific techniques... for liquid organic manure (liquid animal manure, fermentation residues from biogas plants etc.) ensures such even and low-loss application that it brings a substantial improvement in efficiency. This means savings on mineral fertiliser and environmental protection at the same time.



“Don’t apply slurry at the wrong time ...”



- NO SLURRY APPLICATION IN AUTUMN ..., except for catch crops and rape, because all other crops can no longer make sufficient use of the slurry.

Used properly, and if taken into account sufficiently in fertiliser management, all these measures also increase the nitrogen efficiency of the entire farm.

Success at any price does not make sense – measures must be cost-effective and necessary

In its assistance programmes in the environmental sector, the European Union pays special attention to ensuring that the measures not only produce demonstrable environmental effects, but also have a suitable cost-benefit ratio. This was determined separately for each measure in WAgriCo. Measures with little effect but high costs were rejected from the start.

The following tables show the annual reduction in nitrogen surpluses liable to leaching in kg per hectare as a result of individual, area-specific measures, and also how much it costs per measure to reduce nitrogen input by 1 kg per hectare per annum. The measures shown here were classified by WAgriCo as efficient.



Benefits and ecological impact of measures tested in WAgriCo

Selected measures	Annual reduction of nitrate surplus which is liable to leaching per hectare by ...	Annual costs per kg reduction in nitrogen
(Winter-hardy) catch crops	approx. 30 kg	approx. € 3.00 to 4.50
Fallow land, multi-year greening	approx. 55 kg	approx. € 2.20
Reduced soil cultivation after maize	approx. 8 kg	approx. € 3.75
Non-application of slurry in the autumn	approx. 15 kg	approx. € 1.35
Exact slurry application techniques	approx. 13 kg	approx. € 2.50
Turnips as catch crop before winter grain	approx. 20 kg	approx. € 2.00
Self-sown rape	approx. 15 kg	approx. € 3.20
Organic farming	approx. 45 kg	approx. € 4.25

If, as in WAgriCo, the need for measures and the acceptance of the measures are known, these figures can be used to draw up national or regional cost plans for programmes of measures.

Transfer to agri-environmental programmes

If meaningful water conservation measures are to fit into public assistance programmes, e.g. agri-environmental programmes, they must satisfy the following minimum conditions:

- Controllability
- Acceptance
- Low administrative input
- Ecological effectiveness
- Good cost-benefit ratio

This is necessary because the programmes use public money that has to be handled sparingly.

To this end WAgriCo has compiled a list of all water conservation measures for implementing the EC WFD in the agricultural sector (including consultancy service).

These are all measures which are accepted by the farmers and which are to be taken into account in agri-environmental programmes in Lower Saxony from 2010 onwards.

Synergies – Make use of other environmental programmes as well

For endangered groundwater bodies it is worth making use of projects with other protection objectives and harnessing them for the goals of the EC WFD as well. This requires the following steps:

- Good research into all relevant protection and planning projects under existing and planned programmes in a region and the measures involved.
- Examining the water conservation impact of these measures.
- Combining these areas with the EC WFD target areas, in order to show "synergy areas" on maps.
- Offering ongoing technical advice to other bodies responsible for measures, so as to optimise their measures in the water conservation field. ■



Areas of nature conservation contribute to a good groundwater quality



VI. Checking progress along the way

Progress review of programmes of measures

To observe what changes take place

The preceding chapters have described ...

- how to identify groundwater areas with high pollution and how to ensure optimal placement of agricultural measures there,
- and the existence of a wide range of effective measures for this purpose.

In these measures, the entire procedure is based on ...

- national thinking,** to meet the obligations to the EU,
- regional planning,** to take action where pollution is greatest,
- local implementation,** to find farmers to carry out the measures,

Once these steps have been done successfully, all that is missing is evidence of whether the measures have effects and on what scale. This calls for a monitoring plan, in other words a measuring network for observing changes.

In progress review, the entire procedure is therefore based on ...

- local checking,** to see what effects the measures have on farms and land,
- regional estimates** of the change in pollution of the groundwater bodies,
- national reporting** on how a member state is nearing its environmental objectives.

WAgriCo has brought all three levels together in a common "Guide to large-scale impact monitoring". This describes ...

- how to register on a local and regional basis the ecological impact of implemented packages of measures, especially for endangered groundwater bodies,
- and thereby demonstrate to the EU that the environmental objectives for groundwater are gradually being achieved.

LOCAL progress review on participating farms

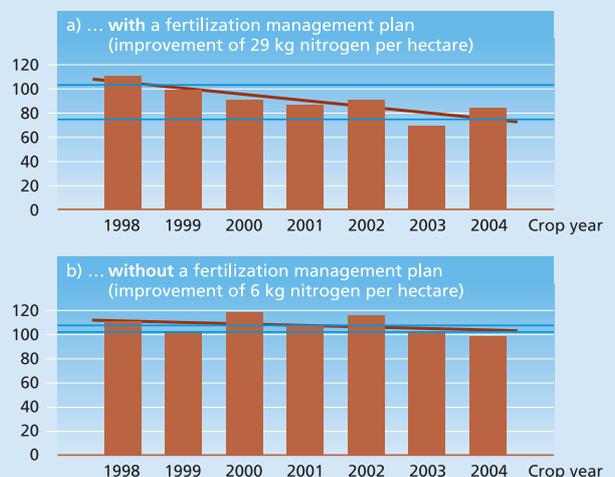
Here the project recommends farm nitrogen balances. This involves annual recalculation of the nitrogen excess for the entire farm. When this gradually decreases with the assistance of the water conservation consultancy service and when there is an increase in nitrogen efficiency, this is a measurable result.



This is only possible on the farm – calculation of balances to decrease nitrogen excess

It is known from the drinking water protection consultancy service that farm nitrogen excesses can be reduced by means of advice and area-specific measures. This is also possible in areas with EC WFD measures.

Nitrogen-surpluses on farm-scale



Success of the consultancy service – Decreased nitrogen excesses due to concrete fertilization planning in a drinking water protection area in Lower Saxony



REGIONAL progress review using data from drinking water abstraction areas

It is not possible to make an annual determination of the positive effects of all individual water conservation measures. This would be far too expensive and is not in fact necessary.

Instead, one can make use of the extensive annual measurements (soil analyses, seepage water analyses etc.) in the drinking water abstraction areas where comparable measures are in progress. Using the state-wide calculation model described in Chapter IV for nitrogen, these effects can be scaled up and shown for groundwater bodies or parts thereof.

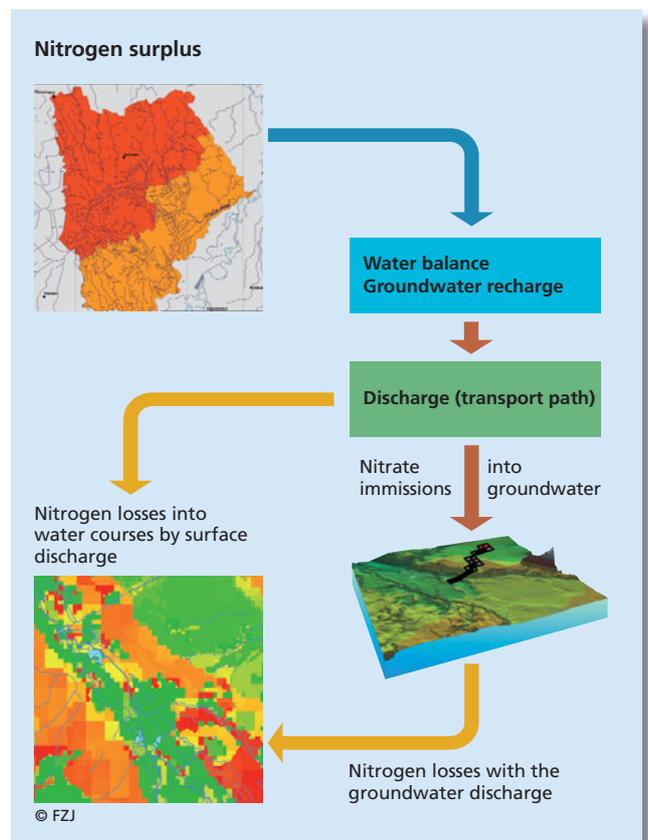
STATE-WIDE progress review using nitrogen models

As described, the regional progress review can already be combined with state-wide calculation models for nitrogen. This makes it possible to update the state-wide pollution situation, which can then be reported to the European Union.

However, experience of impact monitoring to date also indicates that where the reduction requirement is very high, it may not be possible to achieve the environmental objectives. ■

Depth Range		Method/Results
Farm/Soil Surface	 ... good documentation necessary	Nutrient Balancing/ e.g. Farm Gate Balance
Root Zone (0 – 90 cm)	 ... carrying out soil analyses	Autumn Soil Mineral N
Percolation Zone	 ... measuring the leachate quality	Vertical Nitrate Profile/ Leachate Quality
Upper Groundwater Zone	 ... measuring the ground water quality	Groundwater Sampling/ Groundwater Quality

Useful for the implementation of the EC WFD – efficiency control results of drinking water protection areas



Models help to identify pollution trends with regard to nitrogen impacts on water bodies



VII. What is important to farmers in both countries

In a nutshell

Long-term participation on an equal footing

- The farmers, as those who implement the measures, are the crucial force in achieving the targeted groundwater quality objectives. Nothing is possible without them, but a great deal with them. The farmers in Lower Saxony and the UK take exactly the same view on this point.
- Lasting establishment of water-conserving management practices calls for cooperation between farmers, advisors, authorities and researchers not only at local, but also at regional and national level. And this must be on an equal footing, i.e. the playing field must be level.

Practice-oriented measures

The imperatives demanded by farmers are ...

- Simple and easily understood measures
- Compensation that permits short-term adjustment to normal cost trends
- Consultancy service to accompany the measures
- Unbureaucratic procedures for administration of measures
- More flexibility in negotiating measures, i.e. shorter contracts instead of the present five year obligation for each individual agri-environmental measure.

Another important point the farmers would like to see ...

Since environmental effects targeted by appropriate management practices in the agricultural sector take several years to make themselves felt, the farmers recommend longer project periods for future projects. They are on the opinion that this is the only way to arrive at meaningful results.

Measures do not make profits, but are a service to society

Farmers do not make profits by implementing the measures. The rewards are strictly keyed to the approach "(environmental) service against reward", in other words they only provide compensation for increased expenditure or reduced profits.



At the GREEN WEEK in Brussels – the EU Commissioner for Environment Stavros Dimas catches up information on the WAgriCo project

VIII. How others can benefit from WAgriCo

Transferring methods, results and experience



WAgriCo helps individual EU member states with the task of planning and implementing measures aimed at compliance with the EC WFD. It has many modules, initiatives and ideas to offer. These may be of greater or lesser importance depending on the problems in the individual member states. Read on to find out what this includes:

Methods that can be used at governmental level ...

- ✓ to determine individual environmental objectives for agricultural nitrate reductions for individual groundwater bodies,
- ✓ to identify districts with a great need for measures,
- ✓ to find target farms and target areas for implementing the measures within these districts,
- ✓ to offer effective water conservation measures for these farms and areas via agri-environmental programmes,
- ✓ to review the progress of the impacts of these measures,
- ✓ and finally to obtain trend information which can be passed on to the EU.

Organisational forms and working methods for the regions ...

- ✓ to ensure practice-oriented participation by farmers on an equal footing,
- ✓ and thereby achieve great acceptance of the EC WFD objectives,
- ✓ to be able to offer, on this basis, the kind of water conservation measures and water conservation consultancy service that suits the farms,
- ✓ to record the overall success of all these water conservation activities.

On-site water conservation advice and water conservation measures for farmers

- ✓ to increase nitrogen efficiency and reduce nitrogen excess on the farms,
- ✓ to use field-based measures to minimise nitrate leaching into the groundwater,
- ✓ and to register the results achieved by every farm participating.

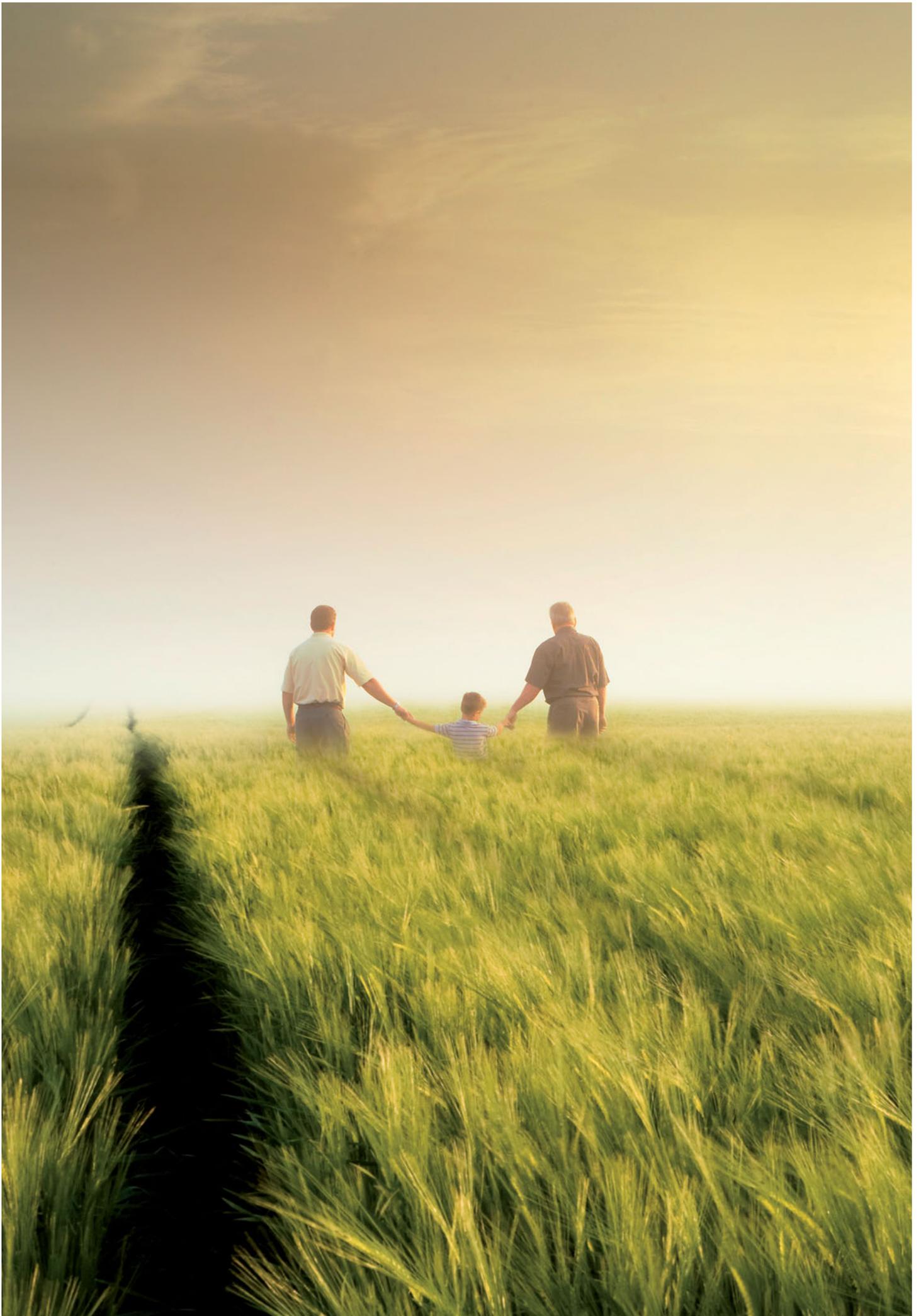
For details of how this works, take a look at the results achieved by WAgriCo. These can mostly be found on the project websites. They include:

- A guide to participation process
- A guide to setting geographical priorities for voluntary measures
- A catalogue of measures
- A concept for the planning and implementation of measures (including consultancy service)
- First outcomes of results-oriented rewards scheme
- Materials for initial and further training
- Guidelines for large-scale impact monitoring

All in all ...

WAgriCo demonstrates to politicians and other persons in positions of responsibility that the EC WFD can be implemented in endangered regions with the aid of farmers, and shows how this can be done with national control, regional planning and local implementation.

With respect to this process WAgriCo has provided essential basics (e. g. instruments, concepts) for the implementation of the EC WFD that can be transferred to other EU member states. The participation structures and concepts developed will also be advanced after the end of the project within the scope of planned or already existing activities. This will be a considerable support for a glueless transition until 2010 when the implementation of water protection measures will start. ■



Success needs partners – project participants in administration, research and the field



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für Umwelt und Klimaschutz



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