

# **The Ythan Project and nutrient budgeting**

## **Evaluation of nutrient budgeting software**

### **1. Background**

In the 1990s concerns were raised over rising nutrient levels in the waters of the river Ythan and their potential impact on the Ythan estuary. Over 90% of the catchment is in an intensive agricultural land use category and hence an obvious potential source for the increased nutrient levels was run-off from fertilisers and animal manures used on farmland. In response to this, the Ythan Project was established, which proposed a number of actions to benefit and improve the River Ythan. One such action was to assist local farmers to gain a better understanding of how nutrients were being utilised on their farms and how they could be managed most efficiently.

The majority of farms in the Ythan catchment area are mixed farms, with arable cropping and livestock. The most frequently grown crops are spring and winter barley, winter wheat and winter oilseed rape, with small areas of seed potatoes and forage turnips. The majority of the livestock in the area are beef cattle, with smaller amounts of dairy cattle and a reducing number of intensively farmed pig units.

The concept of nutrient budgeting on farms is not a new idea and has been used for many years. A nutrient budget aims to put a numerical value on the nutrients entering and leaving the field and quantify any difference between these nutrient levels. If more nutrients are being added to the field than are being taken away, there is a risk that the 'surplus' nutrients could be washed into nearby watercourses. To avoid this, farmers can use a nutrient budget to quantify the levels of nutrients their fields are receiving from both chemical fertilisers and animal manures. However, in the past nutrient budgeting has been viewed as an expensive 'specialist service' which farmers needed to 'buy in' from experts. The cost of doing this was often prohibitive and so nutrient budgeting was only used on a limited number of farms.

Therefore, an aim of the Ythan Project was to make the concept of nutrient budgeting more widely accessible and to enable farmers to complete budgets for themselves, on their own land. It was envisaged that this would be done through the creation of computer software, which could be used on farm computers and would produce a nutrient budget for each field on a farm.

### **2. Software development**

An initial contract specification for creation of the software was produced in July 2002 and was sent to 7 potential contractors throughout the UK. Only two tenders were received in response, and one of these did not meet the requirements of the contract specification

so could not be accepted. The successful tender was submitted by the University of Hertfordshire, Agriculture and the Environment Research Unit, a group who had already produced some agricultural software, such as the EMA (Environmental Management in Agriculture) program.

Work began on the software in 2002 and initial trial versions were available from early 2003. Background data for the software needed to be specific to Scotland rather than the rest of the UK, and so wherever possible the program was based on data from the Scottish Agricultural College technical notes, available through the Scottish Executive, with all data sources being listed in the software database section.

The software was then extensively tested with a variety of farms. Initial feedback was provided to the Hertfordshire team, who corrected a number of bugs and user problems. A finalised version of the software was completed in July 2003 and it was then further tested and assessed on another 55 farms as part of the Ythan Project's aim to assist with budgets on at least 50 farms. A number of other small bugs were found with particular, unusual crop and soil combinations and these were also corrected by Hertfordshire. The final version is now relatively stable, although it is likely that, in common with most computer software, some glitches remain within the system.

### **3. Software outline and description**

**Nutrient balancing section:** this section of the software enables farmers to examine their nutrient (Nitrogen, Phosphorous and Potassium) use and efficiency on both a whole farm and field scale.

The process begins with the user setting up a farm profile, which contains basic information on the farm. Details can then be entered for the whole farm and include what has entered and left the farm and what has been produced on the farm during the time period under consideration. This includes livestock, fertilisers, seeds, feeds, animal manures and soil conditioners. A balance or budget can then be calculated for the whole farm, showing the total amounts of nutrients that have entered and left the farm.

A more detailed analysis can be undertaken on a field-by-field level, with the user entering information on what has taken place in the field during the period. For a cropped field this includes the seed rate used, the yield of crop removed and the fertilisers and animal manures spread on the field. For a grazed field it includes an estimate of the yield of grass and the type of livestock in the field as well.

**Fertiliser recommendations section:** this section was originally developed as a module for the EMA-Scotland software, but was also incorporated into the Ythan Project software. It enables the user to calculate a fertiliser recommendation for a particular crop or grazing regime, and can also take into account the nutrient value of livestock

manures applied to the field, enabling the farmer to reduce the fertiliser recommendation accordingly.

**Other modules:** a number of other modules from the EMA software were also included in the Ythan Project software, where it was felt that they might be of use to farmers in the Ythan catchment, along with relevant documents such as the Prevention of Pollution from Agricultural Activity code.

#### 4. Software evaluation and findings

The software has been extensively trialled on over 60 farms now and hence it is possible to draw some conclusions on its use and value. These are subdivided into its environmental impact, its usefulness for farmers and its potential extension / repeatability in other areas.

**Environmental impact:** a key aim behind the development of the software was to enable farmers to manage nutrients more effectively on their farms, and thereby ensure that the nutrients applied are those that are required by the crop, reducing the risk of excess nutrients being leached into nearby watercourses. To assess whether or not this has happened, it is necessary to look at the existing levels of nutrient use on farms and compare them with the recommended nutrient levels as produced by the software. The table below shows a comparison of these levels:

<b>Crop</b>	<b>Nitrogen</b>	<b>Phosphorous</b>	<b>Potassium</b>
Winter wheat (average used on farms visited)	194	38	75
Winter wheat (recommended by software for field after cereals)	180	43	85
Winter wheat (recommended by software for field after OSR)	140	43	85
Winter wheat (recommended by software for field after cereals with 25t/ha spring dressing of cattle FYM)	172	5	0
Winter barley (average used on farms visited)	181	34	66
Winter barley (recommended by software for field after cereals)	170	41	81
Winter barley (recommended by software for field after OSR)	140	41	81
Winter barley (recommended by software for field after cereals with 25t/ha spring dressing of cattle FYM)	162	0	0
Spring barley (average used on farms visited)	97	25	50
Spring barley (recommended by software for field after cereals)	130	28	58
Spring barley (recommended by software for field after OSR)	90	28	58

Spring barley (recommended by software for field after cereals with 25t/ha spring dressing of cattle FYM)	122	0	0
Winter OSR (average used on farms visited)	209	34	65
Winter OSR (recommended by software for field after cereals)	208	31	42
Winter OSR (recommended by software for field after cereals with 25t/ha spring dressing of cattle FYM)	200	0	0
Grazed field - stocking density approx 2LU/ha (average used on farms visited)	151	11	28
Grazed field - stocking density approx 2LU/ha (recommended by software)	100	17	33
Silage field – yield of approx 10.5 tons dry matter / ha (average used on farms visited)	153	18	49
Silage field – yield of approx 10.5 tons dry matter / ha (recommended by software)	150	22	141

(Assumptions for recommendations: other mineral soil, average yields and rainfall, fields located near Ellon, Aberdeenshire)

As there is a variety of crop combinations there is no single conclusion that can be drawn from a comparison of the fertiliser rates being used on farms in the Ythan catchment and the recommendations produced by the software. In most cases it can be seen that the nitrogen levels recommended are slightly lower than those being used, whilst the phosphorous and potassium levels are slightly higher. However, once the value of any livestock manures applied to the field are taken into account, the phosphorous and potassium levels recommended drop significantly. Whilst in reality it is unlikely that the full nutrient value of livestock manures can be utilised by the crop, this does indicate that the total amounts of nutrients used on farms could be reduced if the value of any livestock manures was also taken into account.

This has been the case on a number of farms visited and so the use of the software has the potential to have an environmental impact in the Ythan area, if farmers decide to utilise some of its recommendations. In some cases farmers have decided to try some of the recommendations on a percentage of their farm, so they can gauge what impact it has on the crop. If the crop's growth and development is not adversely affected, then there is no reason why farmers may not implement the new regime across the whole farm. However, inevitably any such change will take time and it is unlikely that we will see full recognition given to the nutrient value of animal manures on farms for some years.

**Relevance and usefulness for farmers:** as shown above the software clearly has the ability to provide some useful outputs for farmers in terms of nutrient usage on their farms. An additional consideration is how user-friendly

it is and whether or not farmers can get to grips with the program relatively quickly. General feedback from farmers has been that the software is acceptable for those who already use computers on their farms, but it is too complicated for those who are new or inexperienced with using computers. This potentially limits the number of farms where the software can be used, although the number of farmers with limited computer experience is likely to decrease over time. However, any future developments of this, or similar, software should consider how it can be made more 'user-friendly'.

**Extension to other areas:** the software's use in other geographical areas is currently limited by the amount of climatic data it contains. Information on an area's climate is necessary for some of the calculations and at the present time climate data has only been entered for northeast Scotland. The software could potentially be used elsewhere in Scotland by incorporating additional climate data. However, its use further afield would be limited by the amount of data it contains on different crop types. At the moment it contains data on the range of crops grown in northeast Scotland and this may be very different to the type of crops grown in other areas of Europe. However, the basic budgeting concept could be applied elsewhere, if data on climate, crop types, soil types etc were collected.

## 5. The future

As the funding for the Ythan Project has now come to an end, it is important to consider what will happen to the software in the future. Those farmers who already have the software installed on their computers may use it in future years to continue to assess their nutrient usage. A number of agricultural advisors in the northeast Scotland area have been given training in how to use the software and so they may assist clients with budgets in the future. Copies of the software will continue to be available for farmers who request it from the Aberdeenshire Council office in Ellon.

It is likely that other projects will continue to take forward the concept of farmers completing their own nutrient budgets. Project staff are aware of both the Scottish Executive and Scottish Natural Heritage considering taking some form of continued software development forward in the future. Whilst this may not utilise this particular software package, it will build on the concept established by the project that nutrient budgeting is something that farmers can do for themselves, with some form of computerised assistance.

As part of this evaluation of the software, Ythan Project staff produced a list of potential changes and improvements which could be made to the Ythan software, many of which were based on the experience of using the software on so many farms. This list was sent to Hertfordshire, who provided a quote for the cost of completing these potential improvements (see attached). Although the Ythan Project is not in a situation to take forward any further work on this software, it is hoped that this quote will give other projects an idea of what could be done with the Ythan software in the future.

Additional information on the Ythan Project software is available at [www.ythan.org.uk](http://www.ythan.org.uk) or at [www.herts.ac.uk/aeru/projects/ythan](http://www.herts.ac.uk/aeru/projects/ythan)