recommendation, expressed as kg of fertilizer per hectare of land, to a more farmer-friendly measure. Few if any small-scale farmers will have access to scales to weigh out the fertilizer and not all will know the size of the plots they are using to grow each crop. To overcome this problem, the calibration tool is based on the use of items that are freely available and that can be adapted and used as calibrated measuring scoops. These include cut-down, discarded plastic bottles that previously held water or some other liquid; bottle tops, such as the crimped metal bottle-tops commonly used to cap beer or soda (known as crown corks); or rectangular containers, such as empty match boxes. The calibration tool runs on a computer.

First the dimensions of the container to be used are entered; the tool uses these to calculate the volume of the cylindrical or rectangular container. Secondly, the type of fertilizer being used is selected from a drop-down menu: not all fertilizers have the same density, so one bottle-cap full of one fertilizer will have a different weight to the same bottle-cap full of another type of fertilizer. Next the number of kg of fertilizer to be applied per hectare is entered, along with the method of application (broadcast, banding or point placement, also known as micro-dosing) and the distance between rows and plants within rows.

Based on the information provided, the calibration tool provides a user-friendly fertilizer recommendation; for example, instead of 40 kg DAP per hectare it might suggest a plastic water bottle lid full of DAP applied as a band 2.1 meters long.

Step 2: Next a simple nutrient substitution table is used to adjust the output of the FOT to take into account other integrated soil fertility management (ISFM) practices the farmer is using that impact on nutrients supply. The ISFM practices to be included in the table are the use of various types of organic fertilizer (manure, compost, crop residues), intercropping and rotations with legumes, fallows and the results of selected soil tests. For each practice, the table will suggest how the fertilizer recommendations generated by the FOT should be adjusted.

Where to find the OFRA tools
The FOT tools are available at http://africasoilhealth.cabi.org/tools/fertilizer-tools
The reports section of the website http://africasoilhealth.cabi.org/reports/ contains value information, including the OFRA monograph series.

Step 3: Finally a fertilizer calibration tool is used to convert the output from the FOT after clicking on the optimize button to a more farmer-friendly measure.

A better approach to enable small-scale farmers to derive the most benefit from their modest investments in fertilizer.
Farmers who do use mineral fertilizers often buy compound fertilizers. This can make them food insecure and prevent them from generating cash incomes from the sale of surplus crops – locking them in to a cycle of poverty. Even if farmers wish to apply some mineral fertilizer to their crops, it is difficult for them to know the right fertilizer to apply at the right rate of application. Most existing fertilizer recommendations tell farmers how much fertilizer they should apply to a specific crop, usually expressed in kg per hectare. These blanket recommendations often apply to huge areas, even up to whole countries, and encompass several agro-ecological zones. Such recommendations do not help farmers decide which of their crops a farmer wishes to grow, such that the farmer’s return on their investment in fertilizer is maximized.

Fertilizer Optimisation is an approach designed to address many of these issues. Some crops respond better to the nutrients applied than others and different crops need different nutrients for the crops produced is important. The solution

3 complementary tools, based on the principle of
capital optimization, have been developed for use in
a range of agro-ecological zones in Mali.

Fertilizer Optimisation Tool (FOT) is used. Different FOTs have been developed for different agroecological zones in Mali. FOTs were developed using data generated from several series of crop-nutrient response trials carried out in Mali, both prior to and under the auspices of the Optimising Fertilizer Recommendations for Africa (OFRA) project.

The tools are intended to be used by extension workers who have been specially trained. Working with a farmer, the extension worker uses the set of tools to generate fertilizer recommendations which reflect farmers’ specific circumstances, including hectares of the different crops grown, fertilizer prices, expected output farm gate prices, how much the farmer can afford to spend on mineral fertilizer that growing season and other relevant farming practices, such as use of manure. The recommendations generated for each farmer will be different, ‘tailor-made’, but in all cases the solution provided will result in the greatest return on the farmers’ investment in fertilizer.

The problem

Most small-scale farmers in Mali apply little or no mineral fertilizers to their crops. They also usually incorporate organic matter into the soil so that it is ideal: manure and compost is often available only in limited amounts on small-scale farms; for crop residues, including straw and stover, there are often competing uses, such as for animal feed or bedding, or thatching materials or as fuel for cooking. In addition, organic matter is bulky and therefore expensive to transport and handle. The result is that these farmers’ yields are lower than they could be. This can make them food insecure and prevent them from generating cash incomes from the sale of surplus crops – locking them in to a cycle of poverty. Worse still, continually cropping land without returning the nutrients removed with the crops results in degraded and impoverished soils which are hard, sometimes impossible, to restore to good health.

Even if farmers wish to apply some mineral fertilizer to their crops, it is difficult for them to know the right fertilizer to apply at the right rate of application, at the right time and in the right method of application. Applying the wrong fertilizer, applying it to the wrong crops, or applying it at the wrong rate could all result in the farmer failing to benefit from the fertilizer they purchased – they could waste their ‘hard-earned money’.

Most existing fertilizer recommendations tell farmers how much fertilizer they should apply to a specific crop, usually expressed in kg per hectare. These blanket recommendations often apply to huge areas, even up to whole countries, and encompass several agro-ecological zones. Such recommendations do not help farmers decide which of their crops a farmer wishes to grow, such that the farmer’s return on their investment in fertilizer is maximized.

A set of three complementary tools, based on the principle of fertilizer optimization, has been developed for use in a range of agro-ecological zones in Mali. FOTs were developed using data generated from several series of crop-nutrient response trials carried out in Mali, both prior to and under the auspices of the Optimising Fertilizer Recommendations for Africa (OFRA) project.

The tools are intended to be used by extension workers who have been specially trained. Working with a farmer, the extension worker uses the set of tools to generate fertilizer recommendations which reflect farmers’ specific circumstances, including hectares of the different crops grown, fertilizer prices, expected output farm gate prices, how much the farmer can afford to spend on mineral fertilizer that growing season and other relevant farming practices, such as use of manure. The recommendations generated for each farmer will be different, ‘tailor-made’, but in all cases the solution provided will result in the greatest return on the farmers’ investment in fertilizer.

The 3 complementary OFRA tools

Step 1: First the Fertilizer Optimisation Tool (FOT) is used. Different FOTs have been developed for different agroecological zones in Mali. FOTs were developed using data generated from several series of crop-nutrient response trials carried out in Mali, both prior to and under the auspices of the Optimising Fertilizer Recommendations for Africa (OFRA) project.

• North Sudan Savannah
• Sahel
• South Sudan Savannah

The FOT currently runs on a computer or tablet. The FOT is based on a Microsoft Excel spreadsheet. It uses Solver, a standard tool within the Excel spreadsheet which can be used to identify optimal solutions. An even simpler ‘paper-based’ version is developed based on look-up tables that will need no electronic gadgets.

For the version currently available, using a computer or tablet onto which the FOT has been loaded, the extension worker and farmer together enter the hectares of the various crops being grown, the price of fertilizers available, the expected price for crop outputs and how much money the farmer has to invest in fertilizer. They then press the ‘optimize’ tab. The Excel Solver then generates a table showing how much of which type of fertilizer should be applied to which crops. The solution, expressed as kg of fertilizer per hectare, aims to maximize the financial return on the money spent on fertilizer.

A second table indicates the expected yield increases and net return on investment for each crop. A third table shows the total net return on the investment in fertilizer – that is the total value of increased yield of each crop less the amount invested in fertilizer.