



Transforming **U**nsustainable
management of soils in key
agricultural systems in EU and China

Developing an **i**ntegrated platform of
alternatives to reverse soil degradation

Fertilisation management



This project receives funding from the European Union's Horizon 2020 Research and Innovation action under grant agreement No 101000224.

Short description

Fertilisation management is a crucial task in a farm. There is a need of balancing various objectives, as enhancing crop production, reducing costs, respecting limits set by agri-environmental regulations, and maintaining a good status of the soil health. As sometimes fertilization has contrasting outcomes on these objectives, Decision support tools can help farmers in setting a good nutrient management plan, also based on the farm specific aims.

Target area

All crops need a nutrient management plan that considers the crop itself, the cropping system, environmental conditions, soil characteristics, soil nutrient status, and fertilizer availability. The mass-balance is the most used approach because it has several advantages, such as the fact that is easy to explain to farmers, relatively easy to apply and integrate into application tools, but it also allows planning and tracing fertilisation operations. The mass balance is particularly suited for NPK fertilization of cereals or other arable annual crops with high nutrient uptakes. It can be used as a complement to precision fertilization techniques that support fertilization decisions based on



remote or proximal crop nutritional status observations during crop growth. It is not well suited for vineyards and some fruit trees where the amount of nutrients to be supplied is low, and it is difficult to know some entries, such as biological N fixation, amount of pruning residue production and their nutrient concentration.

Problem identification

The calculation of crop nutrient requirements allows that no excessive or insufficient amounts of fertilisers are used, to ensure that all nutrients are available at a correct amount. An unbalanced fertilization can result in depressing soil life, or deplete soil inner reserves in a way that menace its future functioning. An evaluation of the actual fertilization management adopted

in the farm, and calculation of average requirements, can be supported by the TUDI soil fertilisation app (dev-tudi.web.app).



Detailed description of protection

The adoption of a Nutrient management plan requires the calculation of crop requirements and soil supplies through a software/application, or simply using spreadsheet calculations. Some data regarding the crop type and expected yield, previous crop residue amount and management, soil status and climate data are needed. The farmer should enter this information at a single field level. A digital farm operation register can help the farmer reduce the effort of manual data input and the time required to fill the form.

Specific algorithms estimate the contribution of various sources to plant nutrition, such as soil organic matter mineralization, biological N fixation by legumes, preceding crop residues mineralization, past organic fertilization legacy, and N atmospheric depositions. It is important to know the soil nutrient status, and in particular the soil organic matter content and C:N ratio, but also the available P and extractable K concentrations. If the soil is already well provided in P and K, the fertilization should be reduced or even zeroed, as excessive supplies can be harmful to the environment, as they can be lost and cause water/air pollution.

The calculation will generate an expected crop fertilization requirement, based on a standard year data, expected yield and standard nutrient concentrations. An agronomist is often needed to help farmers understand and translate into practice the suggestions given by the tool. In addition,

the agronomist can help the farmer identifying the best timing for nutrient fractionation, based on the characteristics and constraints of each farm. This is properly called Nutrient Management Plan, that puts together information on the amount, the time and the type of fertilizers to be used.



Some decision support tools integrate several layers of available information on the soil, land use, crop status, and weather forecasts to help the farmers decide on fertilization.

Pros/Cons of technique, obstacles to implementation

The main advantages of adopting a fertilization management tool are: i) Maximisation of crop yield and quality; ii) Improved soil health due to more balanced nutritional status; iii) Reduction of costs due to excessive fertiliser distributions; and iv) Reduction of losses to the environment, with beneficial effects on water and air quality.

On the other hand, the main expected drawbacks are i) A fee can be asked to use commercial apps; ii) Some data will require a manual input by the farmer; iii) A privacy policy on data should be carefully read and understood by the farmer; and iv) a soil analysis is needed for each field.

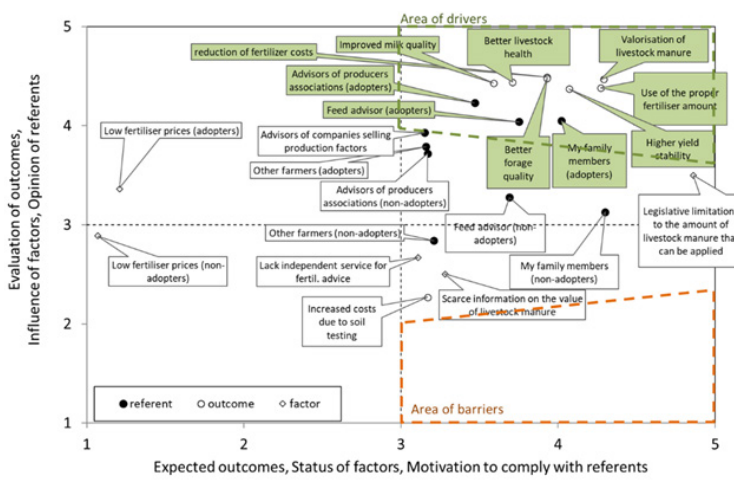
Effects/results/case studies

A fertiliser requirement calculation will ensure that fertilisers are distributed based on the crop requirements, also taking into account the soil available nutrients. The nutrient contents of manures or other organic amendments/organic fertilisers produced in the farm is often unknown by farmers, thus leading to imbalanced nutrient supplies. At a single farm, some crops, such as maize, could be overfertilized, while some others, such as grassland, could be underfertilised. Both conditions can be avoided by the adoption of a fertiliser management calculator.

More literature

Additional information at <https://www.farmers.gov/conservation/nutrient-management>

Additional information at <https://www.fao.org/agriculture/crops/thematic-sitemap/theme/compendium/scpi-practices/integrated-nutrient-management/en/>



Farmers have a lot of expectations on the adoption of a Nutrient management Plan. They expect better forage quality, improved livestock performance, reduction of farm costs, higher yield stability. In contrast, they evidence no barrier that could hamper its adoption (Bechini et al., 2020 DOI 10.1016/j.jclepro.2019.118825)

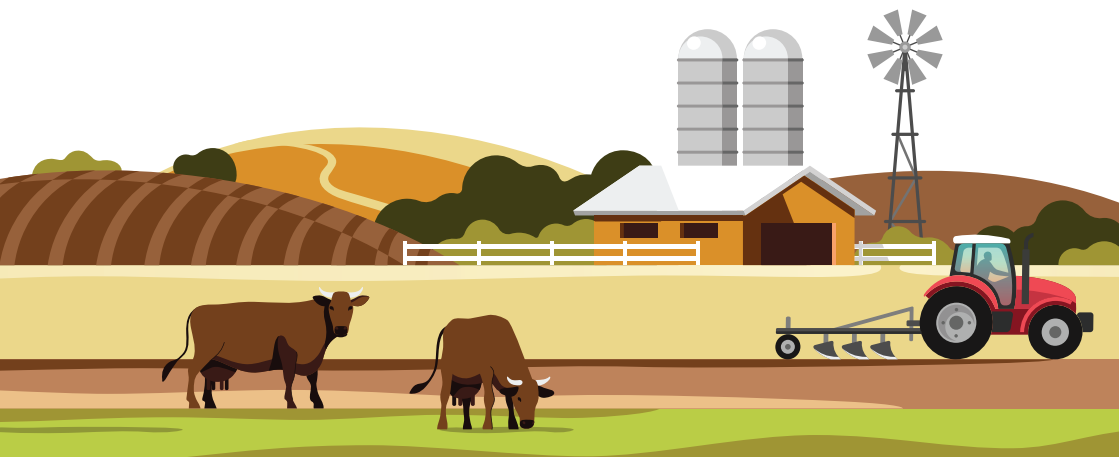
Summary

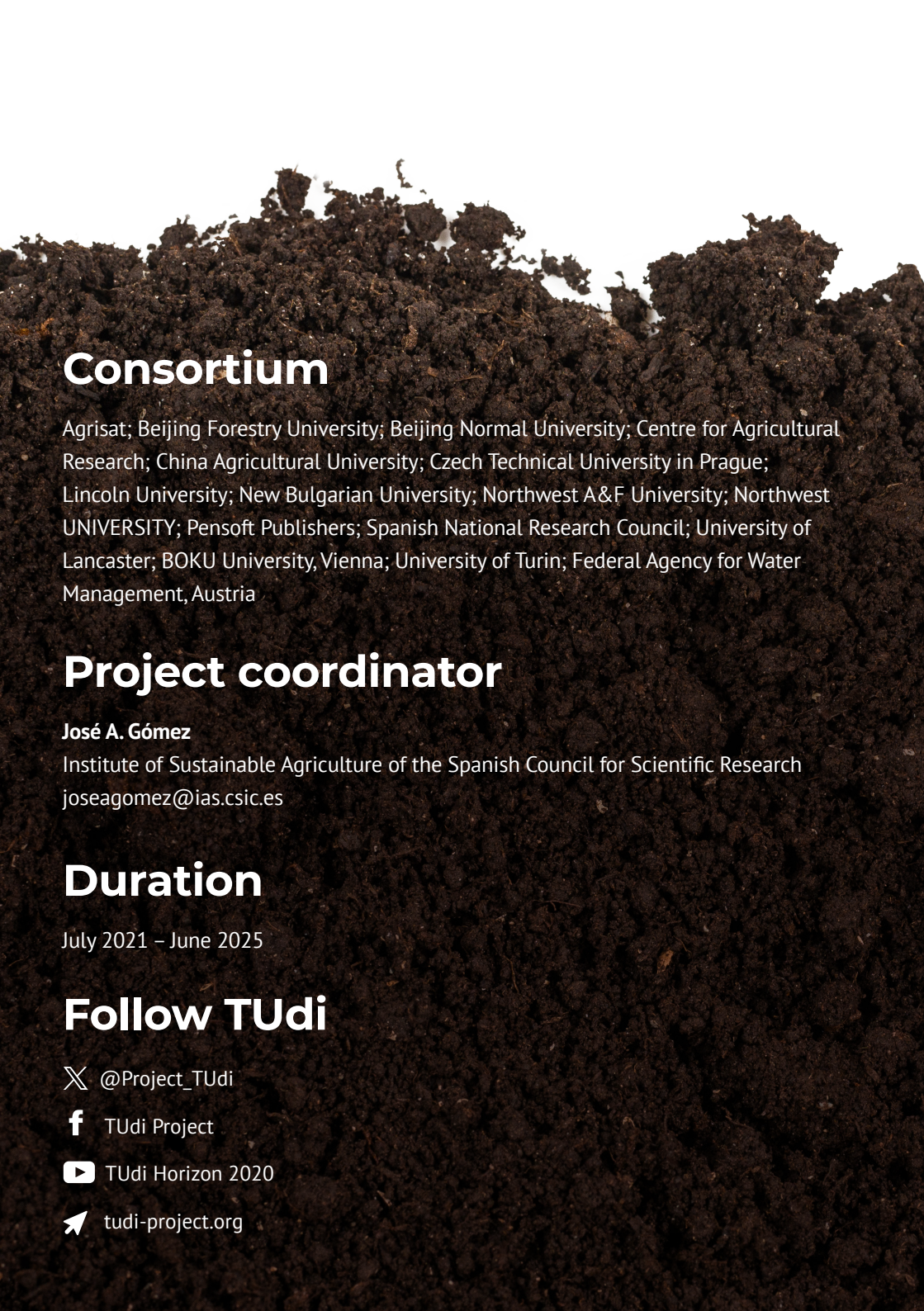
Fertilisation management requires careful calculations for its relevant impact on the farm income, on the crop productivity and quality, and environmental issues, including soil health conservation. A calculation tool is

a cheap and easy way to support decisions on fertiliser distributions. Several tools are available, and should be used as a basis for extension service support to farmers.

Summary table

	Rating	Comments
Soil health overall	***	
Water budget	-	
Soil structure	*	
Erosivity	-	
Nutrient balance	***	
Soil life	**	
Practicability	***	
Economy	***	Additional costs for soil analyses are generally balanced by fertilizer saving





Consortium

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