Multiple NBS approach in England

NBS CASE

The benefits of an NBS will depend on the system and environment in which it is implemented. The experimental platform at Rothamsted Research explores the importance of this contextualisation for the effective implementation of NBS. Multiple NBS are being trialled at two sites with contrasting soils and climate on a long-term platform started in 2017.

By studying combinations of NBS, interdependencies are being identified in the context of seasonal variation in weather. The objective is not to optimise the system but to provide the evidence base for predicting 'what works where'.

The NBS that are being trialled are:

- **Crop Rotation** (Increased functional diversity and addition of legumes and perennial leys)
- **Green compost** (organic fertiliser-Green Waste) and / or cover crops.
- **Reduced Tillage**
- **Integrated Pest Management** {IPM} (non-chemical, companion cropping, resistant cultivars, delayed drilling)

The experiment is designed to quantify not only the benefits of an individual NBS on, for example, crop yield or reduced nitrogen losses, but also the interactions with all the other NBS. Each plot, therefore, represents a contrasting cropping system with a different combination of 1,2,3 or 4 NBS.

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Challenges addressed by the NBS

NBS have the potential to substitute for synthetic inputs of fertilisers and pesticides and so mitigate the negative environmental impacts of crop production:

1. losses of nutrients to the environment (greenhouse gas emissions and water pollution)
2. declining biodiversity. However, these environmental and economic benefits are only realised when inputs are reduced.

Farmers, therefore, require robust evidence on the contribution of NBS to crop nutrition and regulating pests, diseases and weeds before making these decisions. Only then can the increased efficiencies of the system be reflected in farm profits.

The platform is not designed to address a specific challenge, therefore, but to study trade-offs between agronomic, environmental and economic outcomes to provide this evidence base for decision making.

Outcome envisioned:

- The contribution of NBS to soil fertility and nutrient cycling and the potential for reducing synthetic fertiliser inputs.
- The contribution of NBS to yield resilience and quality (including protein content).
- The contribution of NBS to regulating pest, weed and disease pressure and the potential for reducing synthetic pesticide inputs.
- The contribution of NBS to achieving carbon neutrality by reducing diesel use, emissions and inorganic nitrogen and increasing soil organic carbon.
- The contribution of NBS to farm profitability.
- The contribution of NBS to supporting farmland biodiversity.

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Which biophysical, agronomic, and farm management implications does the NBS have at field and farm level?

Data from individual plots and years provide evidence for field scale benefits of NBS. These include:

- **Improving soil health**
- **Reduced pest, weed and disease pressure**
- **Increased yield and yield quality**

When plots are integrated across each of the rotations over multiple years, the platform provides evidence on the benefits of NBS at a farm system level including:

- **Nutrient use efficiency**
- **Progress towards net zero (greenhouse gas emissions and carbon sequestration)**
- **Biodiversity**
- **Farm profitability**

Providing an overview of the behaviour of the different systems against multiple criteria provides a basis for querying management decisions either at the individual field or whole farm level. The former will include the option of reducing synthetic inputs and the latter may involve diversifying the crop rotation.

Which indicators/criteria are used to assess the success of the NBS in addressing the challenge?

The success of the NBS in addressing its challenges is assessed using the following indicators/criteria:

The contribution of NBS to achieving environmental, agronomic and economic sustainability is being assessed using indicators in three categories:

1. Increase of natural capital: soil health indicators (including soil organic carbon and functional biodiversity)
2. Productivity: yield and yield quality quantified in terms of total calories, protein and nutrient content
3. Nutrient use efficiency: Inputs of synthetic fertiliser / offtake – capturing losses to the environment.
4. Farm profitability: Cost of operations / income from produce or access to natural capital markets.

These indicators provide a comprehensive assessment of the NBS's success in addressing its challenges.

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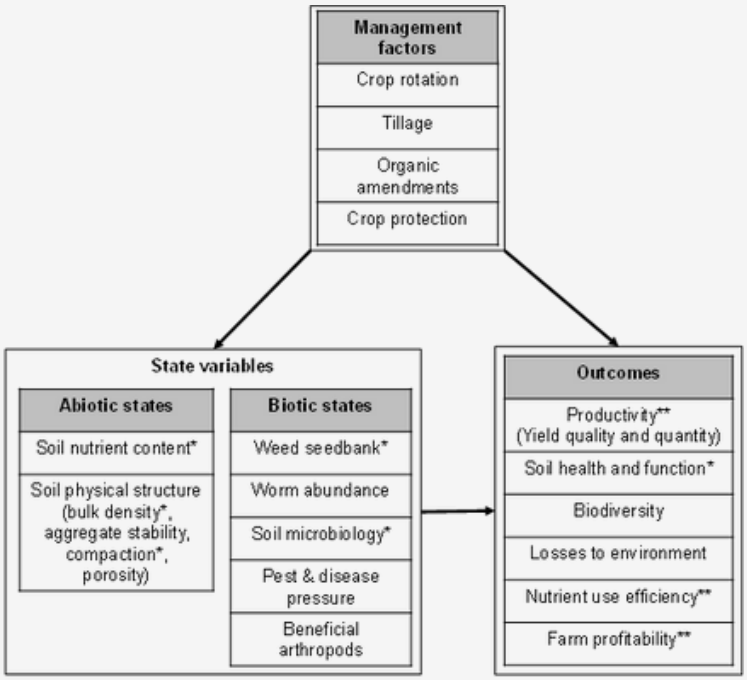
What methods/tools are used for the NBS assessment?

As well as assessing the effect of the NBS on outcomes directly, we are using analytical approaches, including structural equation models, to attribute causality to changing states in the system and to quantify the relative impact of individual NBS and interactions between them.



*Core measurements taken in baseline year and every third year
**Recorded every year

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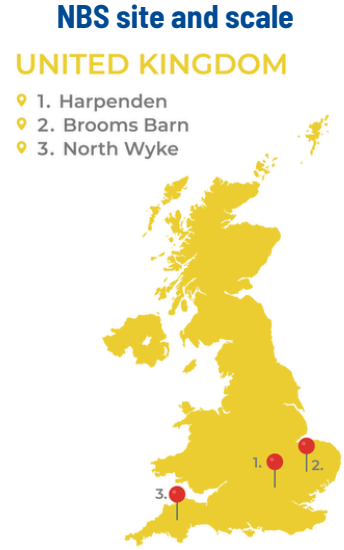
NBS site and scale



trans4num is a four-year project funded under the Zero Pollution call as an EU-China international cooperation action on nature-based solutions (NBS) for nutrient management in agriculture.
trans4num ambition is to broadly enhance the NBS implementation in Europe with an integrative and tested multi-level approach, in dialogue with academic partners, practice partners and societal stakeholders.

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