

# Sustainable Business Models for Carbon Sequestration in Soils to Enable Food System Transformation

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## Extended abstract

The mounting societal grand challenges call for innovative solutions and business models allowing transition towards a more sustainable future. Food system transformation represents one of the key areas to addressing these multiple interlocking challenges, including climate change, biodiversity loss, soil erosion, and groundwater depletion whilst continuing to provide safe food and economic opportunities for rural areas (Daum, 2023). However, at present, food systems instead contribute to exacerbating the problems (Herrero et al., 2020), and there is a crucial need for innovations enabling transition towards more sustainable practices. One key dimension in the green transition in agriculture, which has largely been neglected, is soil (Tahat et al., 2020).

Consequently, soil health has lately gained increasing global awareness and has been recognized as critical to achieving the United Nation's Sustainable Development Goals (Lal et al., 2021). The recent EU 2030 Soil Strategy (European Commission, 2021) asserts that healthy soil is an integral element in meeting climate, water quality, biodiversity, and long-term economic objectives. Yet, soils are under threat, as the majority of soils in Europe are estimated as being not healthy (European Commission, 2021).

Hence, there is a need to adopt soil management solutions that improve the carbon capture, microbial biodiversity and thus productivity of soils as a foundational element of a more sustainable food system. Sequestering more carbon in soils appears to be a highly promising management practice in this regard. Carbon sequestering in soil has been shown to have multiple 'win-win' benefits on soil productivity leading to increased crop yields combined with a high potential of greenhouse gas emission reduction (Carlisle, 2016).

Furthermore, well-covered, carbon-rich soils can reduce disease outbreaks, provide pest control, and exposure to soil microbes can reduce allergies (Lal et al., 2021).

There are a wide range of possible soil management practices that can increase carbon in soils. The most common ones are diverse crop rotations, cover crops, agroforestry, reduction of soil tillage, fertilizers rich in organic carbon, and permanent grassland (Paulsen et al., 2020). Some of them require just small adjustments on the farm (e.g., planting cover crops), while others require changes in the entire farming system (e.g., enriched crop rotations, agroforestry) (Demeyer et al., 2021).

However, these promising soil health management practices have proven to be costly for farmers within the current regulatory, market and business frameworks. The main barriers include the following: the opportunity cost for farmers interfering with cash crops, the need for initial investment in equipment or infrastructure, and the need for ongoing investment in seed, labor, and management. Common policy approaches for overcoming these barriers are subsidies, grants, and tax incentives. Nevertheless, these have experienced limited success. As a result, adoption of sustainable soil health management practices remains low (Carlisle, 2016). Hence, there is a pressing need for new solutions to ensure that farmers are paid and supported for their effort to store carbon in soil (Van Colen & Lambrecht, 2020).

One of such solutions can be sustainable business models where companies invest in carbon sequestration practices at local farms to contribute to local sustainable food production and reduce their climate footprint. This can make carbon sequestration in soils economically viable for farmers whilst transforming the sustainability performance of the food system, reducing net emissions, enhancing soil health, and sustaining future agricultural productivity.

The current study aims to develop such sustainable business models in Norway, where carbon sequestration is especially important. In Norway only three per cent of the country is categorized as arable land (World Bank, 2023), which means that a comprehensive soil protection strategy is needed to ensure local food production (Government.no, 2023). As the first step, we mapped existing business models for sequestering carbon in soils. Four common types of business models valorizing carbon sequestration exist. These include models within the agrifood chain, models outside the agrifood chain, models at farm level, and models including government institutions (Van Colen & Lambrecht, 2020). We identified seven international projects based on carbon credit business models and three projects with a particular focus on improving soil quality and increasing biodiversity on farmland instead of measuring the actual amount of sequestered carbon. The former category includes 'Valuta voor Veen' (Netherlands), 'Nori' (USA), 'Carbon Farming Initiatives' (Australia), 'Soil and More' (Germany), 'Agreena' (Denmark), 'Svensk Kolinlagring' (Sweden), 'Carbon Action' (Finland), while the latter includes 'Flowering stripes' (Germany), 'Platteland in the bloemetjes' (Belgium), and 'Land Lease'

(Netherlands). In addition to these international projects, we investigated three Norwegian cases offering carbon compensation to companies: DownToEarth (providing biochar to farmers), CHOOOSE (offering the platform for integrating climate action into customer experiences) and Trefadder (planting climate forests in Norway). Following the identification of these relevant cases, we collected and analyzed secondary data in form of company records, websites, and press reports and conducted in-depth interviews with representatives of the cases to investigate relevant stakeholders and design principles for the value proposition and capture. As a result, we identified the building blocks for the design of business model concepts for carbon sequestration in soils based on the adapted Sustainable Business Model Canvas (Bocken et al., 2018). Our findings serve as a basis for creating preliminary sustainable business model scenarios for carbon sequestration in agricultural soils to foster food system transformation. These scenarios will be further validated and developed through a series of focus groups with Norwegian farmers and companies.

## Keywords

Carbon sequestration, soil health, food system transformation, sustainable business models, agriculture.

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