



(New, rural) business models, their mechanisms and impacts

BM Name	High-tech circular farming
Type	Circular economy
Sector	Agriculture
Organisational scale	Individual/private/family business
Short description	High-tech circular farming aspires to improve natural resource use by recovery for reuse, remanufacturing and recycling. In line with these principles, moving towards circular farming implies searching for practices and technology that minimise the input of finite resources (e.g. phosphate, water), encourage the use of regenerative ones, prevent emissions (e.g. CO ₂ , nitrogen, phosphorus), and stimulate the reuse and recycling of resources in a way that adds the highest possible value for businesses and the food system as a whole.
Mechanism	Three mechanisms are central: first, plant biomass is the cornerstone of human nutrition, it should be used as such; second, by-products from food production, processing and consumption should be recycled back into the system; third, animals should be used for what they are good at (e.g. valorising grass in areas unsuitable for other food production purposes).
Innovativeness	High-tech circular farming aspires, amongst others, to close local and farm-level nutrient cycles, and to reduce the current dependency of intensive husbandry on imported feed concentrates. The prospects of urban food waste, legume crops and the use of insects as alternative protein sources are explored. Other examples of innovative high-tech circularity include the use of surplus manure and urban organic waste for biomass-based renewable energy production. The combination with the use of residual heat for urban heating and in glasshouse horticulture, thereby increasing productivity and environmental performance, provides additional benefits.
Value creation	Mixed – novel combinations of environmental and economic gains, social value plays a limited role
Customers, product/service, revenue streams and main cost items	<p>Customers include food and energy consumers, both distant as well as proximate</p> <p>The products and services provided comprise food, energy and emissions reduction</p> <p>The main revenue streams are reduced environmental costs, and the valorisation and sale of by-products.</p> <p>Main cost items include investments in technology, ICT, infrastructure and logistics.</p>



Societal impact	<p>Beneficial:</p> <ul style="list-style-type: none"> • Re-enforcement of rural-urban relations at regional level • Increased provision of ecosystem services in conjunction with regional agriculture • Novel forms of cross-sectoral cooperation • Reduction in exploitative distant interdependencies <p>Negative:</p> <ul style="list-style-type: none"> • Further industrialisation of farming with serious animal welfare issues • Potential land use conflicts when integrating food production with other types of ecosystem services provisioning • Continuation of animal production-based dietary protein sourcing
Rural-urban synergies	Closing of loops of nutrients, energy and natural resources. Valorising of urban food waste. Renewable energy production. Improvement of ecosystem service performance. Novel linkages between regional urban and rural space.
Connections with labour market and employment effects	Primarily indirect positive effects, such as regaining societal support for agro-industrial food production and continuity in (predominantly urban) employment in the agro-industrial and agri-expert system.
Enabling factors	<ul style="list-style-type: none"> • Smart growth orientation • Intensity of agricultural land use • Urban proximity • Relatively strong farmers' cooperative movement
Limiting factors	<ul style="list-style-type: none"> • Pressure on rural space and conflicts with other rural functions • Loss of societal support for agro-industrial food production • Phytosanitary regulations regarding the re-use of food waste • General loss of competitiveness of regional intensive husbandry
Key partners and actors directly involved	<p>Agro-industrial experts Agro-industry Farmer-led innovation networks National and regional environmental organisations and municipalities National innovation programmes</p>
Role of (local) government	Facilitator, regulator and provider of financial support
Connections with the institutional / policy environment	National and regional environmental organisations and municipalities, and national innovation programmes play a relatively important role. Financial support is provided through a range of national support programmes.
Internal/network governance arrangements	Different forms of cross-sectoral cooperation play an important role involving agricultural, energy and environmental sectors. Novel public-private partnerships facilitate and finance innovative research and start-up investments.
A typical example	<i>De Groene Mineralen Centrale</i> (The Green Mineral Plant) exemplifies how waste flows from urban and rural origin might be regionally brought together and revalorised in multiple products and services. It was set up in response to the surplus of manure in the <i>Achterhoek</i> region and now processes over 100,000 tonnes of pig manure and agro-industrial organic waste per annum. Recently the plant has been extended with a novel nutrient recovery installation converting the digestate into valuable mineral fertilizers and organic soil enhancers.



BM references	The Green Mineral Plant: www.groenemineralcentrale.nl Background info: www.groenemineralcentrale.nl/nl/downloads-1 Circular Farming Info: www.wur.nl/upload_mm/7/5/5/14119893-7258-45e6-b4d0-e514a8b6316a_Circularity-in-agricultural-production-20122018.pdf
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