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UNDERSTANDING & IMPROVING
THE SUSTAINABILITY OF AGRO-ECOLOGICAL
FARMING SYSTEMS IN THE EU

Transition towards carbon-neutral milk in Finland

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Context 1

- **Farming system:** The farming system analysed is a collection of conventional and organic dairy milk farms within the Finnish average of 100-150 cows in the dairy-intensive region of Nivala (Central Finland). The farms comprise of dairy cows and fields used to harvest silage and cereals for feeding the cows.
- **Dilemma:** How to reduce harmful climate, water and soil impacts of dairy farming in Nivala region without sacrificing economic viability of the local dairy sector, by means of envisioning and implementing a multipurpose bio-product plant along the principles of circular bioeconomy, with the aim of producing biogas and organic fertilizers from manure.
- **Main sustainability issues:** Dairy farm intensification is a growing phenomenon in Finland. In order to achieve efficiency, larger farms are being established. Thus, less labour is needed in sparsely populated areas in the countryside to produce milk. From an environmental perspective, increasing concentration of cattle conveys an increase in nutrient run-off from manure that results in water quality degradation through eutrophication. Bio-product plants producing both bioenergy and organic fertilizers are seen as a solution to climate change mitigation and water quality problems, as well as, to increasing labour productivity of the dairy farms.
- **Stage of transition examined**: Advancing an on-going transition. In Finland, agri-environmental measures are widely adopted on farms. However, the biogas production, when compared to some other European countries, is still modest. In order to achieve its full potential, a set of governance and market measures applicable to its many by-products such as biofertilizers and liquified variants of biofuels, are needed.

Context 2

- **Key actors involved in the MAP**: Valio (the biggest dairy cooperative and milk processor in Finland), the town of Nivala.
- **Agro-ecological practices identified:** The two main agro-ecological practices that would be applied in Nivala given the installation of the biogas plant are biofertilizer and biofuel production from manure and grass silage
- **Biofertilizer production from cow manure and grass silage:** Produced by separation in a secondary treatment plant. The digestate from the anaerobic digestive process undergoes physical separation to obtain solid and liquid portions with higher concentrations of nutrients (N, P and K). The leftover water can be safely discharged back to the natural environment.
- **Biofuel production from cow manure and grass silage:** Biogas directly in the anaerobic digestion process taking place in plant digester undergoes secondary treatment in a purification plant where biomethane in its purest possible form (99%) is extracted. Biomethane can be compressed or liquified and used as a fuel.

Sustainability implications and trade-offs of practices: Biofertilizers

- Biofertilizer production would substitute the commercial mineral fertilizers used by the farms. This practice has the potential to reduce the adverse effect of fertilizer run-off in water bodies, reduce the carbon footprint from mineral fertilizer acquisition and improve the farmer’s control on nutrient circulation.
- On the other hand, it can increase emissions and costs of transport and reduce the organic carbon in the soils of the dairy farms.

Sustainability implications and trade-offs of practices: Biofuels

- Biofuels would substitute fossil fuel usage both in farms and by the private drivers in the area through the installation of a biomethane refueling station. The benefits of biofuels derive from carbon footprint reduction in fossil fuel substitution and the improved nutrient circulation brough by the anaerobic digestion system.
- To be used on farms however, machinery such as tractors and trucks would need to be upgraded to use liquified biomethane, raising the farm capital costs.
- Biofuel from biogas could thus reduce the dependency of farms on external sources of energy and protect from supply or price shocks that can result for example from global climate change or from various mitigation and adaptation efforts.

Barriers of implementation

- The key barrier for the development of biogas production capacity in Finland is the low return to investment.
- As the return to investment from valorization requires increasing the scale of the plant to such a degree that it needs feedstock from many farms, the transaction costs of managing the feedstock supply increase. Hence, the economic risk in the investment in valorization is high compared to the expected profits.
- The biofuel market too, is uncertain. While biogas demand in traffic use is expected to increase ten-fold by 2035, the competition with the electric vehicles and other biofuels casts a serious question mark over the compressed biomethane market in future.

Barriers of implementation

- Both the biofertilizer and biofuel markets are very dependent on policies guiding agriculture and energy sectors. This brings considerable investment risk in an uncertain policy landscape.
- It is difficult to assess the importance of local of resistance in withdrawal of Valio from the original plant concept that received a positive investment subsidy decision in 2018 and was supposed to be located in the industrial zone near the town center and with lowest logistics costs for the transport of manure.
- While the municipal administration of Nivala supported the project, complaints from some of the town residents could have posed a risk in tarnishing the Valio's milk brand, which far exceeds the additional revenues that the investment in biogas business would bring in the current business environment.

Key actions and instruments to address barriers

- The strategy adopted in Finland is to subsidize the investment costs of biogas plants, include biogas on the list of fuels that can be used to fulfil the obligation of minimum required biobased component for fuel used in traffic, subsidize valorization of the digestate, subsidize the infrastructure for distributing biogas in the transport sector and to promote biogas use in the advisory services and research.
- The stakeholders participating in the online workshop arranged by the UNISECO project in Finland were mainly satisfied with the measures set in the government Biogas Programme of 2020.

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Key actions and instruments to address barriers

- Policy changes supporting small-scale biogas plants that do not use valorization were given the highest priority. The results can also be interpreted as a signal of changing priorities on the type and scale of biogas concept that is more likely to be implemented in practice in Nivala.
- This outcome reflects the participant composition of the stakeholders, including representatives from that business segment besides the local actors from Nivala.
- This could indicate that due to low return to investment in valorization, the strategy is reoriented to build several small-scale plants on farms instead of a more centralized solution combining manure from several farms.

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Key lessons learnt

- In the Finnish case, the valorization of the digestate enters the market defined by traditional policies for both biogas and nutrient management. It competes for funding and feedstock with biogas plant concepts that do not include biofertilizer production. To gain traction, the new technology must demonstrate its benefits (which was difficult to demonstrate).
- In the dialogue of which policies to implement and how to target them, emerging solutions that do not have as solid evidence as the more conventional options can be overlooked. The co-construction process itself can lead to new barriers for emerging technologies.
- In the Finnish case study of Nivala it is rather obvious that the existing policies on national and EU level are the key drivers of transition.

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