Palopuro Agroecological Symbiosis – Increasing sustainability in organic farming

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**Implications**

Agroecological symbiosis (AES) is a novel system that aims for better sustainability in agriculture. A case study of the first AES in Finland (<http://blogs.helsinki.fi/palopuronsymbioosi/>) indicates that productivity of an organic crop farm has the potential to be increased through production of biogas from green manure leys, fallows and other locally available biomasses. At the same time, this farm becomes a net-energy producer instead of being an energy consumer. Combining the food processing, crop production, energy production, and closer interaction with consumers increases the overall sustainability of the local food system

**Background and objectives**

AES is a model which is based on the theory of industrial symbiosis and industrial ecology (Koppelmäki *et al* 2016). Industrial ecology describes a production model in which nutrient and energy flows resemble those in natural ecosystems (Graedel 1996, Graedel & Allenby 1996). Industrial symbiosis refers to operations which are spatially situated in close proximity allowing co-evolution and increased resource efficiency (Chertow 2000).

The first functional incarnation of the AES concept is actively forming in Palopuro village, near the city of Hyvinkää in Southern Finland. A symbiosis exists between three organic farms, a bakery, a biogas company, and community members. The center of Palopuro AES is Knehtilä farm, an organic cereal farm (360 ha). The feed production and manure management of a neighboring organic hen house is integrated with Knehtilä’s production. In the future, the produced grain will be milled and baked by the bakery which will establish its operations on the farm. Energy for the grain drying, farm machinery, food processing, and sales will be produced in a biogas plant; operated in cooperation with local actors and a local energy company.

The aim of this paper is to study, from a biophysical and social perspective, the overall sustainability of a symbiotic model by using the first AES pilot as a case study. From the biophysical side the objective is to measure how the biogas production from locally available biomasses impacts the nutrient and energy flows. From a social perspective, the lived experiences of the producers and consumers will be investigated through ethnographic and other qualitative inquiry.

**Key results and discussion**

Based on the participating farms current crop rotation plans AES will produce renewable energy from green manure leys and manures (gross energy of 2,440 MWh) and shifts the farm from consuming energy to producing energy. The produced energy replaces the fossil energy used in the bakery, grain drying and partly in the farm machinery. The major part (over 60 %) of the energy will be sold for transportation use.

The nutrient-rich digestate will increase the productivity by supplying more soluble nitrogen for the crops compared to traditional use of green manure leys (Seppälä 2014). The risk of nutrient leaching is reduced because the plant material is not left to decompose on the ground in the field (Uusi-Kämppä 2012)

There is a huge potential for farm-scale biogas production in Finland. There are ca. 105000 ha of green manure leys and other non-cultivated areas which would be available for biomass harvesting (Niemeläinen *et al.* 2014). Producing biogas from biomasses that are not competing with food production can be a sustainable way to produce bioenergy. At the same time, nutrient use efficiency is enhanced in organic farms without cattle.

In addition to producing farm scale biogas, AES reconnects farmers, food producers and consumers through a (re)localization of food production. The benefit of local food and producing renewable energy has the potential to improve rural livelihoods.

In summary, the AES-model has the potential to yield higher self-sufficiency for energy and nutrient resources, in addition to the potential of strengthening social capital in rural areas through reintroduction of the producer and consumer and peer-to-peer interaction in the social space provided by the main farm participating in the AES system.

**How work was carried out?**

The biophysical aspects are assessed using nutrient flows and energy production which are modelled as if the biogas plant were already in operation. The actual data was collected from the farms. The area of green manure leys and other fallows in the crop rotation plan was used as an available area for biogas production. The energy potential of the biomasses and nutrient content of the digestate was derived from the literature (Seppälä 2014).

To assess the social sustainability and viability of the model we will employ participatory mapping (Corbett *et al*. 2006), surveys, semi-structured interviews, and participant observation to capture the lived experience of the actors in the system which include the producers, processors, and consumers, and other users of the social space at the farm. Our research interrogates the levels of “locality” present in creation of a (re)localized food system.

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