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Synergies between the expansion of biogas production and organic farming

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Introduction and aim

In June 2009 The Danish Parliament passed a plan for Green Growth, including ambitious goals for the expansion of biogas production to include 50% of all animal manures by 2020, and an increase of the organic farmed area by 150% in the same period, thereby covering more than 15% of the total farmed area in 2020 (Ministry of Economic and Business Affairs Denmark, 2009).

The aim of this paper presentation is to review possible synergies between this expansion of biogas production and the development of organic farming. Especially, we will discuss the rural development perspectives, and the major barriers and problems for such development. This include a discussion of how this development can help to reduce greenhouse gas emissions, and as The Danish Rural Development Program is mentioned as the central policy program to support the Green Growth Plan, it is discussed how such reduction might be combined with new opportunities for rural development.

Materials and methods

Based on information from digital farm registers (Hauge Petersen *et al.* 2006) a national Geographical Information System including information about placement, land use, livestock production and fertilization practice for all Danish farms have been constructed (see www.djf-geodata.dk). In a number of ongoing Research Projects (see for example

http://www.bioconcens.elr.dk, or http://liv-projektet.dk/, Danish Food Industry Agency 2009a) these data are used to assess effects of rural development measures implemented in Denmark, including the present investigation of the effect of expanded biogas production. Figure 1 shows an example of the livestock density mapped for the North-Western part of Denmark based on these data, and Table 1 shows a summary of the derived national figures regarding biogas production potentials.

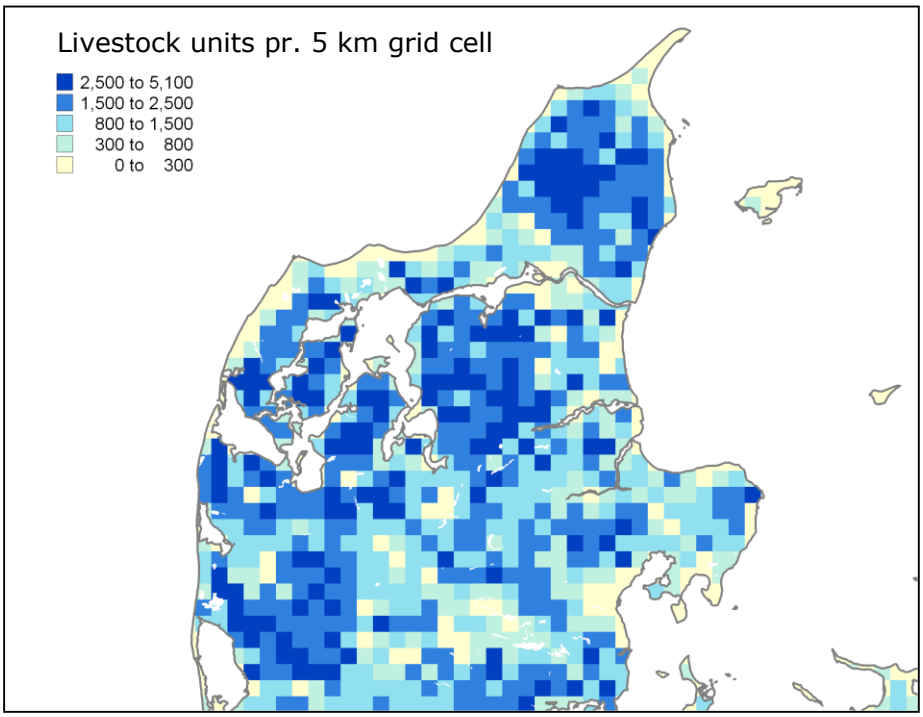

Figure 1. Example on the mapped livestock density in North-Western Denmark 2006. One Livestock Unit (LU) equals 100 kg Nitrogen from livestock manure ex store.

Table 1. Biogas potential summarized from all Danish livestock 2006. It is assumed that all slurry but no other manure sources are used for biogas production in the form of methane (CH_4). One Livestock Unit (LU) equals 100 kg Nitrogen from livestock manure ex store.

	Livestock Units (10^3 LU)	**Slurry proportion** (% of manure)	**Biogas production per Livestock Unit** (1000^6 m^3 CH_4/10^3 LU)	**Total biogas production** (1000^6 m^3 CH_4)
Cattle	1,020	48%	0.361	368
Pigs	1,259	84%	0.281	354
Poultry/fur animals	106	25%	0.376	40
Others	15	8%	0.573	9

Preliminary results

The livestock intensive region of North-Western Denmark has been selected as a case study area (Figure 1), and the biogas production potentials for this region have been mapped (Figure 2).

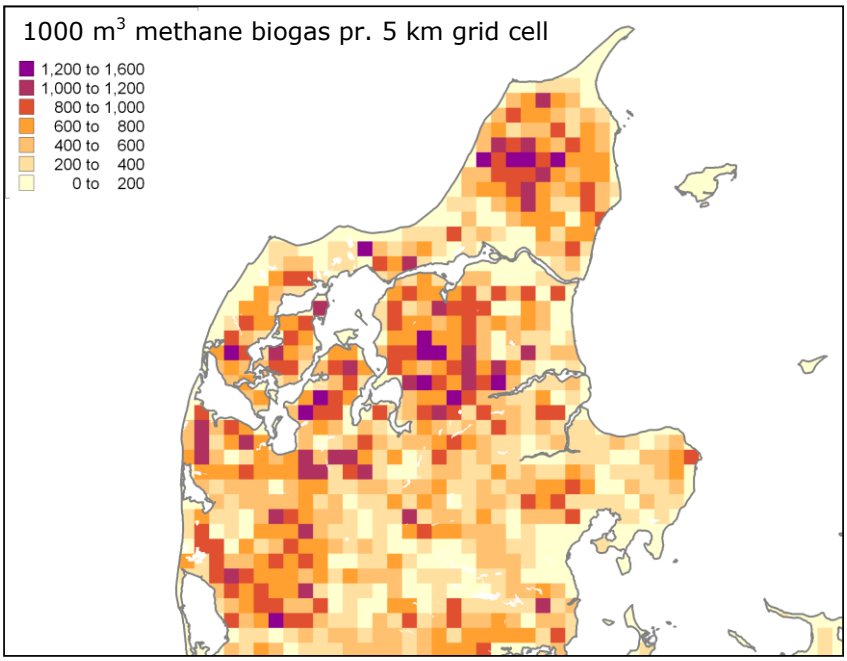

Figure 2. Mapped potential biogas production from livestock manures in North-Western Denmark 2006. Hot spots with a large potential biogas production are the darkest colored areas.

Based on the metods presented in Nielsen and Hjorth-Gregersen (2002), Hjort-Gregersen (2009), the socio-economic consequences of such large-scale implementation of biogas production will be assessed. From the hot spots shown in Figure 2 it is obvious that some rural areas have special possibilities biogas production, and it is interesting that these areas seem to overlap with the areas with special interests in rural development mapped by Kristensen *et al.* (2009).

Moreover, current research results show that especially in livestock intensive areas, the expansion of both organic and conventional farming is limited by the competition for land, but redistribution of manure via biogas plants can help to mitigate this barrier, and create special potentials for the development of more sustainable farming systems (ICROFS 2008, Dalgaard *et al.* 2008a, Kjeldsen *et al.*, 2009). This is demonstrated via results from the ongoing research project on biomass and

bioenergy production in organic agriculture (BIOCONCENS 2009), illustrating examples on the potentials for optimization of nutrient recycling and the reduction of greenhouse gas emissions (Pugesgaard *et al.*, 2008).

Conclusions and perspectives

It is concluded, that the planned 150% increase in organic farm area is realistic and, in combination with bioenergy crop production for the biogas plants, it is even possible to make the organic farming sector independent of manure imports from conventional farming. This will contribute to the vision of a Danish Economy independent of fossil fuels by 2050 (The Danish Climate Commission 2009), and to the special needs defined in the Danish Rural Development Program (Danish Food Industry Agency 2009b), which in the Green Growth Plan is mentioned as the central policy program to support conversion to more biogas production and organic farming. The maps over the total biogas production potentials can be compared with maps over the potential conversion to organic farming in Denmark (see Kjeldsen *et al.* 2009). Thereby regional differences are illustrated, showing that the combined expansion of biogas and organic production has a special potential to support development in areas designated with a special need for rural development (Dalgaard *et al.* 2008b). Based on these results, included in ongoing Rural Development research (see for example http://www.bioconcens.elr.dk, or http://liv-projektet.dk), recommendations for future rural development programs, supporting the expansion of biogas production and organic farming, can be summarized.

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