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Low input breeds and climate change

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The greatest challenge of agriculture during the 21st century is probably to feed the increasing number of increasingly wealthy people on earth while maintaining soil and water resources (Cassmann et al., 2003). Climate change significantly adds to this challenge by reducing the quality of soil and availability of water in many regions and by increasing variability of temperature and rainfall (Tubiello et al., 2007). The already now large contribution of agriculture to global greenhouse gas emissions will increase in importance, unless more effective and climate friendly farming systems are adopted (van Beek et al., 2010). The challenge of agriculture in within the climate change context is therefore two-fold, both to reduce emissions and to adapt to a changing and more variable climate.

Global demand for food is expected to increase by 70% by 2050 (FAO, 2009). The increase in demand for animal products driven by growing populations, incomes and diet preferences is stronger than for most other food items. Global production of meat is projected to more than double from 229 million tonnes in 1999/2001 to 470 million tonnes in 2050, and that of milk to increase from 580 to 1,043 million tonnes (FAO, 2006, 2009). The bulk of the growth in meat and milk production will occur in developing countries, with China, India and Brazil already representing two thirds of current meat production. Poultry will be the commodity of choice for reasons of acceptance across cultures and technical efficiency in relation to the use of feed concentrates. Food supply must increase sustainably to meet this demand and this will be complicated by climate change (Foresight, 2011).

The global animal food chain generates 18 % of global greenhouse gas emissions as measured in CO_2 equivalents (FAO, 2006). Livestock production systems emit 37% of anthropogenic methane most of that from enteric fermentation by ruminants. Moreover, they induce 65% of anthropogenic nitrous oxide emissions, the great majority from manure. Furthermore, livestock production would also induce 9 % of global anthropogenic CO_2 emissions. The largest share (i.e. 7%) of this derives from land-use changes – especially deforestation – caused by expansion of pastures and arable land for feed crops (FAO, 2006).

European studies have shown that the consumption of food products, beverages, tobacco and other stimulants contributes 21-31 % of the total EU greenhouse gas emissions. Meat and dairy products are the foods that have the greatest impact on climate. Vegetables generally have the smallest contribution to global warming. Agricultural production is the link in the production chain, which for all food products is associated with the largest emissions, whereas in general only a smaller part of the emissions come from manufacturing, packaging and transport. Initiatives to support climate-friendly food should therefore primarily be directed to improving agricultural practices.

Life-cycle analyses of food production systems in Denmark have shown that the annual emissions of a milk cow is about 14 ton CO_2, from a sow with associated production of fatteners about 7.5 ton CO_2, and arable crop production about 3.5 ton CO_2 per ha. An analysis of available measures for reducing emissions show that the realistic potential for emissions reductions in Danish agriculture is about 15, 20 and 30 % for dairy, pig and arable production systems, respectively. At the global level the largest reduction potentials are found for accumulation of carbon in restoring degraded lands and avoiding CO_2 emissions from intensive cultivation of peat soils (Smith et al., 2008).

Organic farming contributes to emissions of the same greenhouse gases as conventional farming. However, management is in many respects different in organic systems, and this affects both soil carbon storage and emissions of methane and nitrous oxide. There are few experimental and modelling studies that compare greenhouse gas emissions from organic and conventional farming. However, they mostly point to lower emissions from organic systems on a per area basis, whereas there is often little difference in emissions, when organic and conventional systems are compared on a unit product (kg or litre) basis (e.g., Olesen et al., 2006). This is particularly the case for cool temperate climates, where conventional systems normally out-yield organic systems. The higher rate of soil organic matter turnover in warmer climates improves crop nitrogen supply under organic farming in these climates, and organic farming therefore typically does not result in large yield reductions in warm temperate, subtropical and tropical climates. This also means that the greenhouse gas effect of organic farming will be relatively more positive for warmer climates.

As countries put policies in place to curb GHG emissions, the livestock sector will be concerned. While the growth in livestock production will likely take place in countries with relatively low production levels, intensification of production comes at a cost of higher emissions of greenhouse gases (van Beek et al., 2010), these strategies may be ineffective in reducing emissions while at the same time causing economically, socially and even environmental negative spillovers. Understanding how policy frameworks addressing climate, energy or agriculture will affect the livestock-climate nexus is thus urgent; their social acceptance and cost-effectiveness across animal production systems being central issues. Moreover, some lobbying groups advocate for reduced animal product consumption in OECD countries, pointing at the sector's effects on the environment and animal welfare, and at the public health issues associated with high consumption levels.

References

Cassman, K.G., Dobermann, A., Walters, D.T., Yang, H., 2003. Meeting cereal demand while maintaining natural resources and improving environmental quality. Ann. Rev. Env. Res. 28, 315-358.

FAO, 2006. Livestock's Long Shadow. Environmental Issues and Options. Food and Agriculture Organisation, Rome, Italy.

FAO, 2009. How to feed the world in 2050. Food and Agriculture Organisation, Rome, Italy.

Foresight, 2011. The future of food and farming: Challenges and choices for global sustainability. The Government Office for Science, London, UK.

Olesen, J.E., Schelde, K., Weiske, A., Weisbjerg, M.R., Asman, W.A.H., Djurhuus, J., 2006. Modelling greenhouse gas emissions from European conventional and organic dairy farms. Agric. Ecosyst. Environ. 112, 207-220.

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H.H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, R.J., Sirotenko, O., Howden, M., McAllister, T., Pan, G., Romanenkov, V., Schneider, U., Towprayoon, S., Wattenbach, M., Smith, J.U., 2008. Greenhouse gas mitigation in agriculture. Phil. Trans. Roy. Soc., B. 363**,** 789-813.

Tubiello, F.N., Soussana, J.F., Howden, S.M., 2007. Crop and pasture response to climate change. Proc. Nat. Acad. Sci. 104, 19686-19690.

van Beek, C.L., Meerburg, B.G., Schils, R.L.M., Verhagen, J., Kuikman, P.J., 2010. Feeding the world's increasing population while limiting climate change impacts: linking N_2O emissions from agiculture to population growth. Env. Sci. Pol. 13, 89-96.