Legume Futures

Legume-supported cropping systems for Europe

Comments on the Third Standing Committee on Agricultural Research Report

Response of Legume Futures to the SCAR consultation

The Legume Futures consortium welcomes the contribution that this document makes to framing the debate regarding food security and its interrelationship with environmental issues.

The opening section provides a valuable definition of the scarcity concept and forms a basis for debate and action that relates to the wider scarcity issue. The comparison of the productivity and sufficiency narratives provides a stark comparison of the choices faced by societies in coming decades. The consequences of these approaches could be more fully explored. There appears to be a reticence on the part of the authors to undertake such an analysis, possibly because it would highlight the weakness (in terms of sustainability) of the productivity narrative.

We also welcome the introductory sections that outline the demand-led contributions to changing the overall dynamics of the food industry and its wider impact on the environment The detrimental effects of excess meat production and consumption on health and the environment have been clearly outlined in recent research publications (Steinfeld *et al.* 2006; Galloway *et al.* 2007; Erisman *et al.* 2008). The extrapolation of the recent global growth in meat consumption would be likely to lead to significant pressures on food production systems and the environment (Garnett 2009; Audsley et al 2009). In the UK, the government's Department for Environment Food and Rural Affairs has developed an approach to food security that has overlooked the demand-side pressures. While this may have little consequence for a north European country, it is not aligned with a response from the developed world that will allow a global demand side-approach. The report helpfully positions consumption change as a possibility.

The document pays little attention to the constraints created by the need to address major environmental threats caused by the biogeochemical cycling of nitrogen and carbon. Current trends in agricultural production would lead to more than a two fold increase in global consumption of N fertilizers (Tilman *et al.* 2001). Environmental damage resulting in GHG emissions, loss of biodiversity, eutrophication, acidification and damage to stratospheric ozone make this trend unsustainable(Galloway *et al.* 2002; Galloway 2005; Canfield *et al.* 2010). The fixation of nitrogen for agriculture (either in a factory or by legumes) is the second largest distortion of global biogeochemical cycles after carbon (Erisman *et al.* 2008). The effects are definitely a constraint. The reason it is not mentioned is probably because it is widely assumed that renewable energy or nuclear fusion will provide all the energy required to fix N in the timescales we are talking about. This might be right, but overlooks the effect of this reactive N on ecosystems via ammonia, nitrate, N_2O etc. So leaking of reactive nitrogen is the constraint even if finding the energy to fix the N is not. The scarcity of N refers therefore to the constraints on the use of N that are created by the need to move to sustainable food production systems, rather than any scarcity of the actual resource. SCAR would do well to look carefully at the nitrogen cycle and means to move towards N budgeting as an alternative to the patch-work of 'end-of-pipe' policies

SEVENTH FRAMEWORK PROGRAMME

Legume-supported cropping systems for Europe
(Legume Futures)
is a collaborative research project funded by the European Union through the 7th Framework Programme under grant number 245216 CP-FP
www.legumefutures.de

that exist at the moment, such as the Nitrates Directive. There is a need for radically improved management and innovation within European farming systems to improve the efficiency with which N is used and recycled and to reduce losses to the wider environment. A number of Framework projects address this issue and need to be developed in future funding rounds.

The related issue of C management is also dealt with somewhat superficially. An assumption is made that incentives to promote C sequestration will be largely financially driven as a consequence of C trading. However, a wider systems-level management of agricultural land could promote C sequestration as a component of good agricultural management and the current call "*KBBE.2011.1.2-02: Reducing mineral fertilisers and chemicals use in agriculture by recycling treated organic waste as compost and bio-char products*" is an example of this. There are also opportunities for regulatory interventions (linked for example to payment of subsidies). Consideration also needs to be given to the wider benefits of C management in soil. This includes the benefits of reduced GHG emissions, preservation and improvement of soil quality, and conservation of microbial biodiversity within an ecosystems services framework.

The issue of land use and land use change is given insufficient attention. Since 1850, land use change linked to agricultural expansion and deforestation has accounted for 35% of global CO_2 emissions (Foley *et al.* 2005). This has occurred in part through extensive loss of soil carbon as a result of soil cultivation and degradation. However, these changes also provide an opportunity to reverse losses through the promotion of C sequestration in the development of more sustainable agricultural systems (Smith 2008). Current land use is also associated with large scale perturbations of N and P cycling. For example European agricultural systems rely heavily on imported legumes – particularly soybeans grown in South America. The global trade in soy equates to global movement of more than 10 million tonnes of reactive nitrogen (UNEP & WHRC 2007). The import of soybeans and soy-meal into Europe increased from the equivalent of 3.4 million tonnes of soybean in 1961 to 55 million tonnes in 2006. EU consumption now accounts for about 25% of the world crop and an even larger proportion of the soybean production in Argentina and Brazil. Soy is directly or indirectly linked to deforestation (accounting for about 18% of anthropogenic greenhouse gas emissions), in the Amazon basin in particular (Simon & Garagorry 2005). Soy imports are central to a global flow of resources from South America supporting intensive livestock production in Europe. Overall, Europe's dependence on imported soy is a major economic and environmental challenge for European livestock production, which will intensify (Steinfeld *et al.* 2006) as the global demand for livestock products increases. Legumes grown Europe, including soy, provide an alternative to reliance on this global trade in protein crops and also reduce the demand for synthetically fixed nitrogen in European agriculture. This issue is currently being assessed within the Legume Futures project.

The report considers all agricultural land together – arable and grassland. This is particularly evident when it says that 80% of the agricultural land is used for livestock. This is true, but the grassland area is about twice the arable area and much of it is natural grassland, such as savannah, steppe and tundra that, owing to unsuitable rainfall or temperature distribution, cannot be turned into arable land without serious, negative environmental consequences (White *et al.* 2000). Arable land and intensively managed grasslands (including rotational grass) are critical, and expanding grassland is also an issue where the natural vegetation is or would be forest. Expanding arable land into natural grassland as happened in the Cerrado of Brazil is analogous to deforestation. Likewise, all grassland in the temperate zone, such as virtually the whole of Europe where forest is the climax vegetation, carries an opportunity cost in terms of above- and below-ground C sequestration. So if we want to tackle land use change and restore the carbon-storage function of land, our agricultural land area is much more constrained than data on 'agricultural land area' suggest. This means there is a high carbon opportunity cost to biofuel production if it comes from annual arable crops grown on arable land, or even grassland where forest is the natural vegetation. It is becoming increasingly apparent that first-generation bioenergy from annual food crop species (biodiesel from oilseed crops and bioethanol from cereals) is incompatible with GHG mitigation in the medium term (50 years) because of the increase in net GHG emissions (particularly N_2O) and the wider knock-on effects (Crutzen *et al.* 2008). This is something the EC needs to address urgently, and SCAR needs to get to grips with it. Current EU policy that encourages 'biofuels', particularly first-generation biofuels, poses large GHG risks at the global scale.

The authors should note that the commonly cited view that food production needs to grow by 50 – 70% by 2050 has been challenged in a Soil Association report (Soil Association 2010). That work drew attention to the fact that the population growth will occur in poor communities, so it possible that a lower global growth in food production will occur. In addition, the growth in food demand may be considerably less if the 'West' reduced meat and dairy consumption.

The section on the Agrimonde is poorly explained (Section 4.4).

Water: the section is confused. We cannot treat the circulation of water through a power station as abstraction – it may cause heat pollution, but it is not abstracted. It is an example of muddled thinking common in the water debate generally (embedded water etc.).

GM – the text speaks of GM failing so far to raise yields, or at least disappointing in terms of yields. It falls into the common view that GM traits are about yield. The reality is shown elsewhere in the text where currently used traits are listed. None is about yield. They are all input traits. Yield potential is a very complex set of traits. GM may increase productivity by reducing losses to stress, such as by enhanced salt tolerance or pest resistance, but intrinsic yield increases due to GM, over and above that achieved by modern conventional breeding, are still only at an experimental stage (Koslowsky *et al*. 2008). There is a common misconception of the limitations of GM with respect to food security.

The report implicitly endorses the view that tackling the problems of food security and environmental protection are best achieved by adopting a systems approach to the problem. This view is fundamental to the approach taken by Legume Futures and is essential in tackling the multi-dimensional challenges ahead. It is therefore inappropriate to develop a reductionist approach to solving the problems of food security. The wider societal implications of different choices can only be adequately predicted when all major components scales and interactions are adequately accounted for.

Bob Rees and Donal Murphy-Boken

On behalf of the Legume Futures Consortium

October 2010

Reference list

Audsley, E., Brander, M., Chatterton, J., Murphy-Bokern, D., Webster, C., and Williams, A. (2009). An assessment of greenhouse gas emissions from the UK food system and the scope for reduction by 2050. How low can we go?. WWF-UK and the FCRN. www.murphy-bokern.com

Canfield,D.E., Glazer,A.N. & Falkowski,P.G. 2010. The Evolution and Future of Earth's Nitrogen Cycle. *Science*, 330, 192-196.

Crutzen,P.J., Mosier,A.R., Smith,K.A. & Winiwarter,W. 2008. N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. *Atmospheric Chemistry and Physics*, 8, 389-395.

Erisman,J.W., Sutton,M., Galloway,J.N., Klimont,Z. & Winiwarter,W. 2008. How a century of ammonia synthesis changed the world. *Nature Geoscience*, 636-639.

Foley,J.A., DeFries,R., Asner,G.P., Barford,C., Bonan,G., Carpenter,S.R., Chapin,F.S., Coe,M.T., Daily,G.C., Gibbs,H.K., Helkowski,J.H., Holloway,T., Howard,E.A., Kucharik,C.J., Monfreda,C., Patz,J.A., Prentice,I.C., Ramankutty,N. & Snyder,P.K. 2005. Global consequences of land use. *Science*, 309, 570-574.

Galloway,J.N. 2005. The global nitrogen cycle: Past, present and future. *Science in China Series C-Life Sciences*, 48, 669-677.

Galloway,J.N., Burke,M., Bradford,G.E., Naylor,R., Falcon,W., Chapagain,A.K., Gaskell,J.C., McCullough,E., Mooney,H.A., Oleson,K.L.L., Steinfeld,H., Wassenaar,T. & Smil,V. 2007. International trade in meat: The tip of the pork chop. *Ambio*, 36, 622-629.

Galloway,J.N., Cowling,E.B., Seitzinger,S.P. & Socolow,R.H. 2002. Reactive nitrogen: Too much of a good thing? *Ambio*, 31, 60-63.

Garnett,T. 2009. Livestock-related greenhouse gas emissions: impacts and options for policy makers. *Environmental Science & Policy*, 12, 491-503.

Simon,M.F.& Garagorry,F.L. 2005. The expansion of agriculture in the Brazilian Amazon. *Environmental Conservation*, 32, 203-212.

Smith,P. 2008. Land use change and soil organic carbon dynamics. *Nutrient Cycling in Agroecosystems*, 81, 169-178.

Soil Association. Telling porkies; the big fat lie about doubling food production. 2010. Bristol, UK.
Ref Type: Report

Steinfeld, H., Gerber, P, Wassenaar, T., Castel, V., Rosales, M., and de Haan, C. Livestock's long shadow; environmental issues and options. 2006. Rome, FAO.
Ref Type: Report

Tilman,D., Fargione,J., Wolff,B., D'Antonio,C., Dobson,A., Howarth,R., Schindler,D., Schlesinger,W.H., Simberloff,D. & Swackhamer,D. 2001. Forecasting agriculturally driven global environmental change. *Science*, 292, 281-284.

UNEP and WHRC. Reactive Nitrogen in the Environment: Too Much or Too Little of a Good Thing. 2007. Paris, United Nations Environment Programme.
Ref Type: Report