Title: Integrating livestock feeds and production systems into agricultural multi-market models: The example of IMPACT

Authors: Siwa Msangi[1], Dolapo Enahoro[2], Mario Herrero[3]

ABSTRACT

Multi-market models have been widely applied to foresight analyses of agricultural and trade policies in national and regional development contexts (van Tongeren, et al., 2001). Underlying many models of this characterization is a similar approach in that the behaviors of major players in the economy are represented as sets of demand and supply equations. However, the unavailability of reliable data with good global coverage, particularly for smallholder systems in developing countries, may have meant that the livestock sector has mostly seen highly aggregated, extremely simplified representation in global economic models, with limited applicability to (pro-poor) policy and development strategy (Nicholson 2007).

In this paper we discuss the various ways in which livestock production systems can be incorporated into economic, partial-equilibrium, multi-market models, and the challenges that are encountered in trying to accurately represent the ways in which production and feed mechanisms vary across crop-livestock systems. In this work, the authors aim to bring a better understanding of the feed requirements within key livestock systems for both monogastrics, as well as small and large ruminants, and explore where feed substitution, efficiency improvements and possibilities for introducing markets may be possible. Agro-ecological and other constraints on substitutability of feed sources such as crop residues and grass from grazing lands (for mainstream feed grains and concentrates) are incorporated in the modeling framework.

In the paper, we address a number of challenges that are faced when trying to incorporate a better representation of livestock production systems. Foremost among these is the challenge of reconciling the scientific understanding of livestock feed requirements and production characteristics with the available FAO national data on production, consumption and trade balances – which often have to be re-calculated in order to remain consistent with more disaggregate data on systems-specific livestock numbers and production (Havlik et al., 2011). One dimension of that challenge lies in accounting for the numbers of animals in the 'follower' herd that are not being slaughtered or milked, but still require feed – whereas national statistics tend to neglect this part of the herd in favor of reporting production.

Another key challenge to incorporating livestock production systems into market equilibrium models is the fact that whereas the allocation of internationally traded animal feeds (such as feedgrains and concentrates) can be modeled within a price-driven, static, equilibrium framework – the growth of ruminant herd numbers requires a more dynamic framework in which the stocks of animals have to be distinguished from the 'flow' of new animal births, deaths and offtake for slaughter.

We use an economic, multi-market modeling approach – and describe the necessary enhancements for addressing livestock. This enables us to carry out projections of production gains, food and feed demand increases, and the necessary flows of trade out into the future. The modeling framework also has flexibility to incorporate the potential feed by-products coming from activities like biofuels production.

Key areas for technology improvements, efficiency gains and policy interventions are highlighted in the paper, to help guide important, ongoing policy discussions.

Keywords: agriculture; livestock, foresight; environmental change; economic policy

[1] Senior Research Fellow, International Food Policy Research Institute (IFPRI), 2033 K Street NW, Washington DC 20006, USA, (off) + 1 202 862 5663, (fax) + 1 202 467 4439 and s.msangi@cgiar.org
[2] Scientist, International Livestock Research Institute (ILRI), d.enahoro@cgiar.org
[3] Chief Research Scientist for Food Systems & the Environment, Commonwealth Scientific and Industrial Research Organization (CSIRO), Brisbane, Australia, mario.herrero@csiro.au

References:

Havlik, P., M. Herrero, A. Mosnier, M. Obersteiner, E. Schmid, S. Fuss, and U. A. Schneider. 2011 International Congress, August 30- September 2, 2011. Zurich, Switzerland. European Association of Agricultural Economists.

Herrero, M., P.K. Thornton, A.M. Notenbaert, S. Wood, S. Msangi, H.A. Freeman, D. Bossio, J. Dixon, M. Peters, J. van de Steeg, J. Lynam, P. Parthasarathy Rao, S. Macmillan, B. Gérard, J. McDermott, C. Seré and M. Rosegrant.. 2010. Smart investments in sustainable food production: Revisiting mixed crop-livestock systems. *Science*, 327(5967): 822-825. doi: 10.1126/science.1183725

Nicholson CF. 2007. Review of methods for modelling systems evolution. Discussion Paper No. 3. Targeting and Innovation. ILRI (International Livestock Research Institute), Nairobi, Kenya. 130 pp. Available at: http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1083&context=agb_fac (accessed on 7 Oct 2013)

Rosegrant, M. W., M. S. Paisner, S. Meijer, and J. Witcover. 2001. *Global food projections to 2020: Emerging trends and alternative futures*. Washington, D.C. International Food Policy Research Institute.

Rosegrant, M.W., X. Cai, S. Cline. 2002. *World water and food to 2025: Dealing with Scarcity*. Washington, D.C. International Food Policy Research Institute.

van Tongeren, F., H. van Meijl, and Y. Surrey. 2001. Global models applied to agricultural and trade policies: a review and assessment. *Agricultural Economics* (26): 149-172.