PANEL 8: WORLD FOOD FUTURES: METHODOLOGICAL BASIS AND IMPLICATIONS OF LONG-TERM FOOD PROJECTIONS

ORGANIZER AND CHAIRPERSON

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PANEL DISCUSSANTS

Key System Requirements for Projecting Food Futures. Deficiencies to be Addressed *Charles Riemenschneider (FAO)*

Why Environmentalists are Wrong about the Global Food Situation: Methods and Myths *Mark Rosegrant, Claudia Ringler (IFPRI)*

Comparison of Medium and Long-term Projections of Food Futures *William Myers (Iowa State University, USA)*

A Biophysical Perspective on Medium and Long-term Food Futures *Prabhu Pingali (CIMMYT)*

RAPPORTEUR

T. Satyanarayana (Indian Society of Agricultural Marketing, India)

The formal presentations of the panel members introduced some of the key issues and some background to modelling the world's future food 'situation'. The situation is multifaceted; there is the question of the amount and types of food which will be produced and consumed in possible medium- and long-term states; there are the food security issues about the extent of malnutrition and its distribution between countries and groups; also there are questions of international trade and the macroeconomic configurations which support and lead to particular patterns; there are the issues of needed investment in agricultural infrastructure and in new technology; and there is the ever-present issue of sustainability in the face of the environmental demands made by continuing growth in agricultural and general economic activity.

Underlying the presentations and discussion was the question of whether agricultural economists are overoptimistic about the future scenarios as opposed, in particular, to environmentalists, who appear relatively pessimistic, as

exemplified by Meadows *et al.* (1972; 1992), The Worldwatch Institute and Lester Brown (1996), and also by Darwin Hall who, at this conference, has presented a plenary paper reporting futures modelling concerned with the possible impacts of global warming. Although some contributors felt that it was misguided to attempt to focus the session's debate on conflict between the respective optimism and pessimism of economists and environmentalists, the impression that there is a fundamental difference was if anything reinforced by the proceedings.

Characteristics of agricultural economists' models

Myers, a leader in the FAPRI modelling team, opened the panel's account by providing a brief comparison of the characteristics of some of the main agricultural economists' (AE) models and their projected futures. He focused on the FAPRI, IMPACT (from IFPRI), AGLINK (from OECD), FAO, USDA and ABARE models. Compared to the environmentalist models, these models have relatively short time horizons, the longest being IMPACT at 2020, and FAO at 2010. Given that confidence intervals rapidly widen as the projection horizon is increased, there are strong methodological reasons for not hazarding what would be increasingly less reliable point estimates into the distant future; and there is the quasi-ethical issue that care should be taken not to provoke either panic or overcomplacency by projecting unjustifiably pessimistic or rosy futures in the form of estimates with ever-decreasing probabilities of occurring.

For the most part, the models referred to above are partial equilibrium models, but they all vary in terms of details of structure, objectives and their inputs. FAPRI and the ABARE models are based almost entirely on econometrically estimated equations, whereas the FAO and OECD models have a large input from commodity and country specialists in modifying parameters and projecting exogenous variables, the most important of which are yields.

Key system requirements

No detailed discussion took place as to the ways in which yield projections are generated but, as Riemenschneider argued in his presentation, it is the future trajectory of these which dominates the characteristic outcome of the models. The AE models do not endogenize yields but employ exogenous trends generated judgmentally or econometrically. This is where there is a major difference with the environmentalist models (Meadows *et al.*, 1992; Hall, at this meeting) where the impacts of environmental change on yields are at the heart of the exercise and where large negative impacts are projected in time frames which extend way beyond those explored in the AE model.

One of the key focuses of AE modelling is the impact of policy changes, since as a profession we are naturally fixated on the prospects for controlling events by tweaking the policy variables. Thus the FAPRI, OECD, ABARE and USDA models incorporate specific policy instruments, whereas IFPRI's

IMPACT model introduces policy changes in terms of PSEs, and the FAO model employs a more eclectic approach greatly influenced by expert inputs. This expert input is one of the strengths of this model (Alexandratos, 1995) but it entails a very labour-intensive approach, a characteristic shared by the USDA's modelling systems.

It is fair to state that the FAO model is more concerned with future food security issues than the other AE models. All of them have different levels of commodity and country disaggregation as reflect their objectives, which are dominated by issues of trade liberalization and trade rather than long-term food security. Implicit in their philosophy is that efficient markets will ensure a future food supply–demand balance with constant or falling real prices and marginal improvements in global food security for a total population increasing in line with the UN's projected medium variant.

Myth of environmentalist models?

This optimistic view was endorsed by Rosegrant and Ringler. In their presentation they attacked various positions they associate with environmentalists: they assert the superiority of commercial (and often large-scale) agriculture over 'small (is beautiful)' farming for its continuing contribution to global food security; they cite studies which indicate the limitations of organic farming, and instead state their confidence in modern farming methods and biotechnology; they address concerns about the high chemical dependency of modern farming, the issue of soil degradation and the implications drawn by environmentalists about the adverse consequences of development leading to more general adoption of the diets of the rich. Among their conclusions is the following:

> The methods and myths employed by many environmentalists when confronting the world food system have caused them to be consistently wrong in their assessment of the long-term prospects for global food security. ... incorrect prophecies of doom from environmentalists have contributed to the fatigue with agricultural issues of donors and policy makers, who point to the failed prophecies as evidence that serious concerns about future agricultural development are unnecessary. ... Environmental and resource degradation are not intrinsically limiting to the necessary growth in crop production to meet global demand in the coming decades. Nor is the current path of agricultural development a threat to the global environment.

Unsurprisingly, these views provoked lively responses from participants in the session, with some accusations of overoptimism. Nevertheless, the position was fairly well defended. Robert Thompson agreed with the proposition that Asian diets were unlikely to be transformed by economic growth into current Western ones. It was observed by Gregory Scott that environmentalists, just as much as agricultural economists, examine issues using partial analysis, and that, whereas AE models may have inadequate biophysical underpinning and environmental feedbacks, environmental models contain insufficient recognition of economic behaviour, market forces and macroeconomic relations. Darwin Hall's intervention suggested that the long-term impacts of global warming,

which he projects to be considerable, are in themselves not primarily due to agricultural pollution but rather are (and will be) due to the carbon dioxide released from fossil fuels as a consequence of industrial and urban growth; of course, agriculture contributes something to this industrialization. That could be construed as supporting Rosegrant and Ringler's relatively optimistic view that agriculturally induced environmental degradation is not an overriding constraint to meeting the projected global population's food demands without increases in real prices.

Technological and biophysical limitations

However, a warning note was sounded from the platform by Pingali, chief economist at CIMMYT. He examined some aspects of the technological and biophysical assumptions for food supply growth and highlighted the point that the capacity for exploiting further yield growth for wheat and rice is now very limited. For maize, however, there is a gap between best and average yields which does provide scope for output growth, and Pingali identified other sources of potential growth, such as improved management practices, improved water management and commercialization leading to relocation of production to achieve better exploitation of agroclimatic potentials. He highlighted the need for appropriate (higher) levels of research investment in order that the yield ceilings for the main staples can be raised. This issue of research investment emerged as one of the strongest from this panel session, although it perhaps received less attention in the conference as a whole than on some previous occasions. As Charles Riemenschneider's presentation emphasized, yield projections are possibly the most critical in AE models for establishing optimistic or pessimistic scenarios (given that population projections are usually exogenous), but the basis for these projections is not greatly elaborated. Certainly, in current AE models, there is no explicit recognition of the research investments needed to maintain the past levels of yield growth which are projected into the future. Indeed, it is striking that in Alexandratos (1995) FAO has none of the emphasis on investment which was in its earlier projections in Alexandratos, 1988.

Riemenschneider addressed other desirable methodological requirements for models which are specifically designed to address food security issues. Given the problems of rural poverty, ideally models would endogenize income determination for vulnerable groups and consider in more detail root crops and other staples which often receive little or no attention in trade liberalization models but are of great importance in sub-Saharan Africa. It is also desirable to model outcome in terms of calories supplied and demanded (as Alexandratos, 1995 does) rather than to consider commodities solely in terms of tonnage.

The issues raised by Riemenschneider underline the difficulty of comparing models when the objectives of models differ: for example, prioritizing trade liberalization, as opposed to food security or environment and geoclimate feedbacks. However, many issues were addressed by the session. Among these was the issue of the future time scale to be considered. The AE models tend to focus on the short to medium term, which means their horizon does not

generally stretch to that at which environmentalists' scenarios envisage major collapses in the food and economic systems. Meadows *et al.* (1992) project some scenarios from their World 3 model in which a major collapse (agricultural, population and general economic) begins around 2020, which is the outer limit for current published projections from AE models. That collapse is envisaged to occur as a consequence of environmental pollution, land degradation and loss, water shortages and global warming. Hall, at this conference, had elaborate projections up to 380 years ahead. It should be noted, however, that the scenarios reported by him carry a mixed message; for some regions, agricultural productivity would improve, but in the tropics calamitous outcomes are envisaged. These outcomes are avoidable but Hall, doubtless correctly, envisages the danger that appropriate reactions will be slowed by overcomplacency and unwillingness to face facts and make difficult choices. Economists have considerable faith in the ability of the market to drive rapid corrective responses; others are much less sanguine.

Floor discussion: emphasis lies on hypothetically possible outcomes

One message which strongly emerged from the participants is that care should be taken to avoid any impression that our models generate forecasts but to emphasize that they produce hypothetically possible outcomes. The consequences of giving the impression of making forecasts, and of getting them wrong, are damaging to modelling exercises which are an essential requirement for reaching understanding of interacting systems. AE models are a medium for fostering debate with biophysical and environmental scientists, and it is apparent that much more cooperation between them and agricultural economists is desirable if policy makers with research funds are not to receive conflicting signals.

One thing underlined by this last point is that we must take care to use appropriate criteria to judge the performance of models. Such criteria can only relate to the specific objectives of each model, and confusion will be created if models are applied to exercises strictly beyond their capacities. Since the computing capacities exist, it is in principle possible to enhance the environmental and biophysical feedback systems of AE models, but that in turn runs into the difficulty of establishing research teams with the capacity to grow and change in ways which maintain and enhance the performance of such models.

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