IFPRI Scenarios Workshop Report 3-4th March 2010

1. Introduction

Gerald Nelson at IFPRI organised a workshop that brought together on 3-4th March 2010 in Washington DC three global projects exploring the future of the food system:

- IFPRI Global Futures for Agriculture (http://www.ifpri.org/pressrelease/global-futures)
- Foresight Global Food and Farming Futures (FFF) (http://www.foresight.gov.uk/OurWork/ActiveProjects/FoodandFarmingFutures/FoodandfarmingProjectHome.asp)
- Challenge Program on Climate Change and Food Security (CCAFS) (http://www.ccafs.cgiar.org/)

Each project is developing scenarios exploring the future of the food system but with different purposes. For Global Futures, scenarios will be used to provide ex-ante research evaluation at a global and regional scale. FFF requires quantitative scenarios that its expert group will analyse as part of a wider evidence base. CCAFS is developing regional food system scenarios.

2. Workshop objectives

Gerald Nelson stated the objectives of the workshop:

- Develop 'consensus' estimates of key global drivers, or at least the process for quickly identifying them from earlier scenarios exercises (candidate drivers are income, population, trade and agricultural productivity)
- Facilitate a longer term process of scenario development, including tools for users, that can be helpful to many potential users
- Allow relatively disparate groups with scenario needs to interact with each other

3. Foresight objectives

Foresight participated in the workshop in order to improve and refine a quantitative scenarios work package that has been commissioned from the Institute of Development Studies and is being lead by Professor Sherman Robinson. The workshop was also an opportunity to take forward the objectives of a joint Foresight/Defra modeling workstream, which include supporting inter-model comparison and encouraging data-sharing.

4. Scenarios

Scenario development was explored in presentations by Monika Zurek (Gates Foundation), John Ingram (CCAFS) and Richard Moss (Joint Global Change Research Institute).

Monika Zurek highlighted the fundamental importance of being clear about the purpose for which scenarios would be used. Possible purposes could be dissemination of knowledge, scientific exploration or use of scenarios as a decision-making tool. Assumptions underlying scenarios should be communicated transparently to decision-makers. A preferred scenario development process was outlined; but it should be noted that the process FFF is using to produce quantitative (and possibly qualitative) scenarios is highly constrained by time. The purpose of the quantitative scenarios is at present scientific exploration. [MR - Similar advice on scenario typologies and process can be found in FFF DR10A[1]].

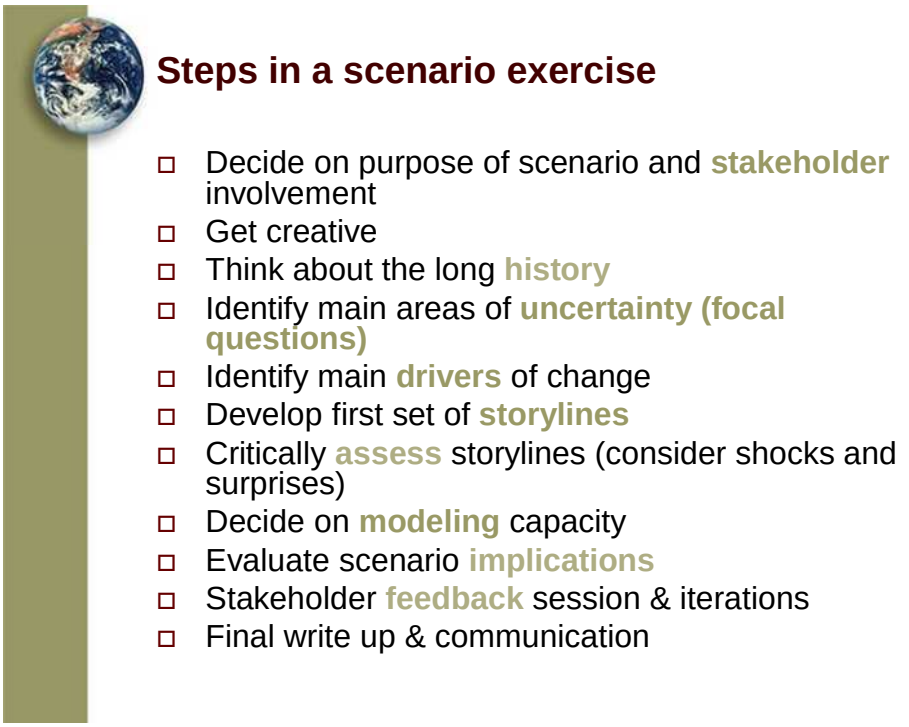

Figure 1, Steps in a preferred scenario development exercise (from Monika Zurek presentation)

Richard Moss disseminated a new process for producing climate change scenarios[2]. Current integrated assessments process has been criticized for being rigid, 'top-down', and lacking sufficient emphasis on impacts, adaptation and vulnerability. Rather than a sequential step-by-step process (socioeconomic scenarios > estimate concentrations and radiative forcing > simulate climate > explore impacts, adaptation and vulnerability), four stimulating normative trajectories of radiative forcing to 2100 have been chosen. Integrated assessment and climate modelers collaborate in parallel rather than work in sequence to explore 'representative concentration pathways' based on the trajectories.

[1] FFF DR10A – Managing uncertainty: a review of existing global food system scenarios and models.
[2] Moss, R et al. 2010. The next generation of scenarios for climate change research and assessment. Nature. 11 Feb 2010. Available URL: http://www.nature.com/nature/journal/v463/n7282/full/nature08823.html.

Moreover, there is potentially a much larger set of plausible futures, which can incorporate non-linear feedbacks and include mitigation and adaptation storylines. Scenarios can be produced that talk to different scales (global, government, local communities, livelihoods, ecosystem services). A scenario library is being created to capture this larger set of futures.

The opportunities of moving from 'top-down' global scenarios to 'bottom-up' regional scenarios was taken further by **John Ingram**. A participatory approach to scenarios was advocated that enhances the scenario development process and better supports stakeholder decisions. Regional richness can be incorporated into global scenarios, whilst improving stakeholder engagement and buy-in. [MR - Evidence suggests that for integrated environmental assessments, knowledge co-production among stakeholders is a stronger determinant of influence than final outputs[3]]

A method of 'coherent' linking of global and regional scenarios was recommended based on the experiences of the Global Environmental Change and Food Systems project[4]. Coherent scenarios possess the same scenarios logic but they could have different drivers, trends and outcomes. 'Coherent' linking can uncover valuable insights at national and local scales, and better support a range of decision-making and planning priorities.

On the other hand, such a process will require careful management. There may be iterative conversations between scales, and the process may require stakeholder involvement early on in any modeling work. The EU Ag2020 project is considered another example of good practice in combining 'top-down' and 'bottom-up' approaches[5].

5. Modeling and modeling frameworks

The workshop went on to discuss the challenge of producing a global scenario framing that might eventually lead to linking at different scales. At this stage common assumptions were sought but a common purpose for the three projects was needed. FFF highlighted its own needs – global quantitative scenarios of the food system that can also enable inter-model comparison. Standardization of assumptions to support inter-model comparison was challenging but some progress would subsequently be made. CCAFS had more time for scenario development, and whilst they were interested in the outputs from such scenarios, there was a preference for a regional stakeholder approach.

[3] Mitchell, R. et al. 2006. Global Environmental Assessments: Information and Influence. Boston: MIT Press. p324.
[4] http://www.gecafs.org/. See also GECFAS Report No.2 'A Set of Prototype Caribbean Scenarios for Global Environmental Change Research on Food Systems' for an example of 'coherent' linking of scenarios.
[5] http://ag2020.org/

Five exogenous drivers of change to the food system were proposed by **Gerry Nelson** in order to begin a conversation on scenarios and quantification of input assumptions:

- Population
- GDP
- Agricultural productivity
- Climate change
- Trade liberalization

Baseline assumptions and some variations were suggested e.g. World Bank GDP growth rates as a baseline and minimum and maximum growth rates from the Millennium Ecosystem Assessment. Note that these drivers for change and suggestions for input assumptions very much reflected internal FFF conversations and the specification for the IDS work package.

Some participants considered this quick, practical method constraining, and arguably out with good practice for scenario development at both global and regional scales. However, this was a method both IFPRI and FFF were keen to pursue.

Dominique van der Mensbrugge provided a presentation on World Bank modeling, which was familiar from previous modeling workshops. However, the World Bank approach was important to discuss because they use a Computable General Equilibrium modeling framework. The World Bank was enthusiastic about inter-model comparison and it proved useful to the group to understand the requirements of their framework for input assumptions and to be aware of the output metrics available.

There are trade-offs between a whole economy (CGE) and multi-market (partial equilibrium) approach. For the World Bank down-scaling to suitable levels of analysis (spatially, markets, households) was a major challenge. Their modeling framework had fewer countries/regions and encountered difficulties in disaggregating commodities. Other challenges included: global hydrological modeling; attaching confidence intervals to outputs; and incorporating discontinuities, and surprises. One participant highlighted the importance of modeling infrastructure damage especially to roads caused by extreme events.

On the other hand multi-market models were limited by less consideration of services and manufacturing sectors. The trade-off was ultimately between agronomic and economic richness. Methods of combining both types of modeling frameworks to create a hybrid framework were being explored.

There were further presentations and discussions on climate, hydrological and crop modeling (**Ken Strezpek**, **Phillip Thornton**, **Claudia Ringler**, **Ricky Robertson**). Key points from these presentations and discussions follow.

Climate modeling:

- IPCC A2 being commonly adopted as business as usual scenario for climate modeling
- Key outputs required from climate modeling are daily minimum and maximum temperature, and rainfall data
- Wide variation at local scales between GCM results at 2100 but nevertheless some consistencies – change in daily precipitation intensity, change in inter-storm arrival, seasonal and spatial variation
- Regional climate modeling using dynamic down-scaling can be time-consuming and expensive
- **Phillip Thornton** has devised a practical method of downscaling that has been suggested by some climate scientists as a way forward – IDS propose to use this method for FFF quantitative scenarios
- Because climate variability will likely increase in the future impacts may be underestimated, tails are thickening

Hydrological modeling:

- Simulation of water availability
- Exogenous non-agricultural drivers of demand are very important
- Future demand from water from municipal, industrial, and energy sectors (e.g. thermo-electric cooling), and associated technologies were key drivers
- Expect more regulation around environmental flows with significant consequences for agricultural water
- Reservoir construction

Crop modeling:

- Challenges around modeling of breeds (seeds/livestock), fertilizer use, and management practices (inc greenhouse gas mitigation)
- CO2 fertilization effects still debatable
- Adaptation is a known unknown (planting dates, crop/cultivar switching, new/abandoning croplands)
- Important to capture somehow irrigation technology and its impacts
- Output metrics from crop modeling are very useful but many, many inputs are required
- Might simplification/modeling of crop modeling still produce meaningful results?

6. Common purpose

The three projects reflected on the outcomes of the workshop so far. FFF made the following points:

- Agreement that frontier in food system modeling is not a super-model but diversity – FFF/Defra want to support a modeling 'ecosystem'

- Good conversations were developing on a good practice process for scenario development and the use of scenarios as a stakeholder tool – to a certain extent the process is the tool
- Coherent linking of regional scenarios to a global framing is a tantalizing process that may be useful in FFF Follow-up
- New method proposed for climate scenarios is a significant step forward in integrated assessment scenario development (indeed a similar method has produced good outcomes in exploring energy system futures[6]) but not feasible at this stage of FFF; Foresight would nevertheless look at the method in much more detail and brief its International Dimensions of Climate Change project
- FFF would be using an 'off-the-shelf' modeling framework to simulate scenarios of the food system; but its choice should not constrain other inter-model comparison
- Projects present need a common purpose before drafting scenario sketches

FFF suggested a common purpose for the remainder of the workshop. Scenario sketches should be produced to provide a global framing. This global framing should i) facilitate inter-model comparison, and ii) offer the potential to link coherently to scenarios at other scales. In the interests of transparency FFF declared that no specific decision had been set aside for the quantified scenarios but the project had a strong S&T element. The IDS work package would be a further piece of evidence for the LEG to analyze. It would also be an illustration of food system modeling. It could, however, be the beginning of a 'bottom-up' process with its High-Level Stakeholder and Project Advisory Groups.

7. Breakout discussions and outputs

The workshop then sought to develop scenarios at the 'edges of the future' to test global food security outcomes. Three groups (Economics, Biophysical, and Regional) were tasked to sketch scenarios (based on an expanded list of exogenous drivers of change[7]) that would produce different outcomes to 2050. Drivers should be quantifiable and modelable; and scenarios should produce numbers that test the food system. Each group was also expected to list output metrics that might be available from any model simulations.

Economics group:

This group produced sketched out global scenarios and produced a plan of action to facilitate inter-model comparison.

[6] Robinson, J.B. 1992. Of maps and territories: the use and abuse of socioeconomic modelling in support of decision making. Technological forecasting and social change. 42, pp147-164.

[7] Population growth, GDP growth, Agricultural productivity growth, climate change, trade liberalisation, climate policy, energy price, non-agricultural technological change, environmental policy

A baseline scenario was suggested:

- Population growth (UN median variant)
- GDP Growth (World Bank, compare with IFPRI assumptions)
- Agricultural productivity (World Bank and IFPRI use different assumptions; IFPRI to produce rates compatible with CGE)
- Climate Change ('Wet' and 'Dry' Scenarios developed by Ken Strepzek for IDS work package)
- Trade liberalization (Business as usual)
- Climate policy (No mitigation via pricing)
- Energy price (Use World Bank base scenario assumptions; may assume some technological change)
- Non-agricultural technological change (World Bank and IFPRI use different assumptions)
- Water (IFPRI input required; irrigation efficiency needs to be quantified across models)

Other issues would have to be addressed. For example, the Clicrop (IDS work package) and DSSAT crop models (IFPRI) would have to be reconciled. Phillip Thornton would have input into the climate change scenarios)

Variations on base scenario were suggested:

- Population growth (High, Low, possibly based on Millennium Ecosystem Assessment Scenarios)
- GDP growth (High, Low)
- Agricultural productivity growth rates (Low)
- Non-agricultural productivity growth rates (Low)
- Climate change (Different scenarios; Phillip Thornton's work?)
- Trade liberalization (Boundary rates; produces big numbers)
- Land supply/land use

Indicators available were:

- GDP growth
- Quantities and growth rates of agricultural output
- Prices (commodities and factors)
- Net trade (quantities and value)
- Poverty (CGE); Malnutrition (IFPRI)
- Water demand and uses
- Land supply and allocation for crops

Biophysical group:

This group discussed what crop modeling could offer to the quantification process. The discussion focused on scale, variety, and CO2 fertilization

- Aggregating and disaggregating data between components – loss of information for some components, overkill for others

- Quality of soil data is an uncomfortable issue and needs to be address– global databases include legacy data; spatial resolution not fine enough; responses to management practices and surface runoff are too big to ignore
- Need to simulate at a daily scale for reasons outlined previously (daily minimum and maximum temperature, and rainfall data)
- Varietal effects can be modeled but it may make sense to explore simpler sets of generic genetic coefficients
- Modeling transgenic crops is a challenge because of timeline/political issues
- Findings from FACE experiments are not appropriate for stressful environments; pest/disease effects not adequately captured; need to differentiate between high and low input
- Water demands for ecosystems not well understood; also construction/destruction of dams has large implications for crops
- Simpler but good enough crop models may be an option although computation power no longer an issue

Indicators available were:

- Yield
- Water and nutrient balances
- Soil carbon
- Biomass

Regional scenario group:

This group discussed a suitable process to generate regional scenarios. The results of the IDC work package and inter-model comparisons would be useful to identify regional issues. In particular a meeting following on from CCAFS launch conference might be a good setting to disseminate initial findings.

Adaption was considered to be important known unknown that is not suitably covered in existing global scenarios such as the Millennium Ecosystem Assessment scenarios. A participatory process was recommended with adaptive capacity as a fixed axis for all regions. A global meeting with regional stakeholders could agree the nature of this fixed axis. Region-specific axes and storylines could then be developed to set boundaries for modeling.

8. Recommendations for action

- FFF to support inter-model comparison between IDS, IFPRI, World Bank and beyond
- FFF to encourage other modelers to simulate scenarios by making available quantified input assumptions
- FFF to check with Hadley whether they approve of Phillip Thornton's method of downscaling

- FFF to share results of strictly unpublished IDS Work Package with IFPRI and CCAFS and encourage dialogue across projects based on these results
- FFF to touch base with John Ingram at CCAFS (http://www.eci.ox.ac.uk/people/ingramjohn.php) by 16th March 2010 for a telephone conversation based around FFF Africa Workshop, CCAFS Launch Conference, FFF Follow-up
- FFF to look at more detail at new method for climate scenarios and to brief IDCC