

27. Questioning long-term global food futures studies: a systematic, empirical, and normative approach

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Abstract

Studies of the futures of food answer questions such as ‘do we need to increase global agricultural production to feed the world sustainably in 2050?’ Conclusions vary dramatically. Similar variations and uncertainties are striking with respect to many other dimensions of food security and food systems. The sheer heterogeneity of methods used to explore the futures of food seems to undermine meaningful comparisons and aggregation between studies. These issues and others compromise responsible collective choices vital for humanity, nonhuman animals, and Earth systems. Disagreements on what policies and social actions we should adopt to shape the future of food depend on how we assess the evolution of food security and food systems over the long-term (at least 20 years into the future). Building upon foresight practice and theory, our team borrows tools from economics, STS, and philosophy to shed light on global food futures and food ethics. In this paper, we will introduce readers to some of our unpublished and provisional findings. We will cover two questions: (1) What does a systematic review of global food security modelling and projection studies reveal about predominant methods, food security indicators, drivers of change, and the range of future global food security projections? (2) Should the usual notion of a ‘plausible’ future explicitly or implicitly invoked in global food futures scenarios to delineate the range of futures worth exploring be modified or abandoned to set free our epistemic, ethical, and political imagination?

Keywords: foresight, plausibility, models, ethics

Introduction

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A glimpse at a systematic review of global food security modelling and projection studies

To address the major and complex issue of food security, policy makers currently making decisions need to have insights into the potential future pathways of global food security. A number of studies have assessed various aspects of future global food security (Baldos and Hertel; 2016; Hasegawa *et al.*, 2015). Often, the results of these studies vary widely and are difficult to compare because of differences in methodology (Godfray and Robinson, 2015), obstacles to structurally comparing the results of global economic and agricultural simulation models (Von Lampe *et al.*, 2014), heterogeneity in definitions of output indicators (Van Dijk and Meijerink, 2014) and divergence in the choice of projections and scenarios (Reilly and Willenbockel, 2010).

Primary and review studies often use the terms ‘projections’ and ‘scenarios’ interchangeably. However, projections are alternative quantitative results of running a model based on different assumptions or inputs. In contrast, a scenario refers to a ‘plausible, comprehensive, integrated and consistent description of how the future might unfold’ (Van Vuuren *et al.*, 2014, 377). In the food futures modelling literature scenarios have a quantitative component (including projections) and a qualitative component, as well as a narrative storyline that links important statements about the future that may or may not be quantifiable. This review focuses on projections and, when relevant, related broader scenarios that global food futures.

Each of the review studies covers only a selection of models, projections and scenarios that have been used in the literature and focuses on a relatively narrow set of food security indicators. In contrast, the goal of our systematic literature review is to rigorously and transparently identify, evaluate, and summarize the results of all global food security modelling studies since 2000. All data will be stored in the Global Food Security Projections Database and can be used by the research community to benchmark the results of upcoming food security modelling studies.

Methods

We used the guidelines for the qualified application of systematic review by the Evidence for Policy and Practice Information and Co-ordinating Centre (University of London) and the Cochrane Handbook for Systematic Reviews of Interventions to organize the review. First, we searched for studies by using six broad exclusion/inclusion criteria: (1) Topic (focus on food security); (2) Global coverage; (3) Projections and scenarios; (4) Quantification (the results of the study are quantified using some type of model, such as econometric, computable general equilibrium or partial equilibrium); (5) Time horizon (the study presents projections for the year 2030 or beyond); and (6) Year of publication (2000-2018). To find the relevant literature, we used global repositories of scientific literature and searched the grey literature. Figure 1 depicts a PRISMA (preferred reporting items for systematic reviews and meta-analyses) diagram that summarizes process and results of our search strategy. The query of the repositories resulted in 3647 studies; 45 studies were included in the database.

One of the aims of this review is to show the range and uncertainty of global food security projections. Unfortunately, the results of the models are not always easily comparable because of differences in projections and variable definitions, methodology and time horizon. In order to make the data comparable, we mapped all scenarios to the Shared Socio-economic Pathways (SSPs) scenarios. The SSPs (Van Vuuren *et al.*, 2017; O’Neill *et al.*, 2017) are a set of five storylines that describe potential but ‘plausible’ global futures: inclusive and sustainable growth (SSP1), business as usual (SSP2), fragmentation through regional rivalry (SSP3), increasing inequality (SSP4) and resource intensive high growth (SSP5).

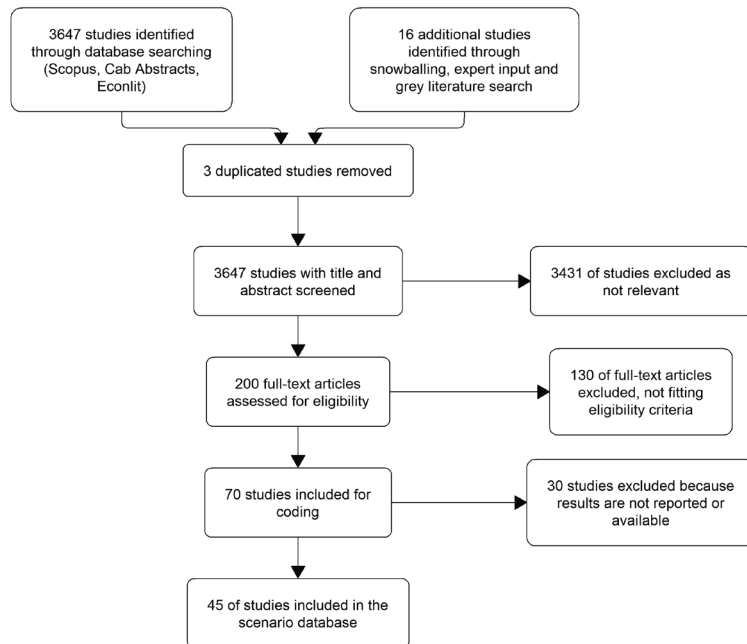


Figure 1. Prisma diagram of the study selection.

Results

The number of global food security projection studies has substantially increased over the last two decades from 1 in 2003 to 70 by 2018. The global food price crisis (2007-2008) resulted in renewed attention to global food and nutrition research including global food security projection studies. There is a transition from studies that present the results of one model to multi-model comparisons that present and discuss the results of an ensemble of models. Many of these studies are produced as part of the Agricultural Model Intercomparison and Improvement Project (AgMIP) that was initiated in 2010.

The majority of studies employ simulation models to project food prices, food demand or people at risk of hunger to the year 2050 (e.g. IMPACT, GLOBIOM, MAGNET). The second most commonly used approaches are statistical models that use regression techniques to estimate future food security (Tilman *et al.*, 2011; Bodirsky *et al.*, 2015).

Comprehensive assessments of future food security should, at least, present a set of indicators that cover all of the four dimensions of food security: availability, access, stability and utilization. The FAO has prepared a comprehensive list of around 20 national-level indicators that capture the four dimensions of food (in)security (FAO, 2018). Comparing this list with the indicators produced by the selected studies suggests that the model studies present a very narrow view of food security. None of the studies presents an indicator on stability and only a few studies address the utilization dimension.

Three factors can explain the large range of food security outcomes. First, in contrast to the AgMIP exercises, where all models use harmonized assumptions on drivers and attempt to align the implementation of qualitative scenario assumptions, the input data of the studies in our review differs considerably. All these differences and variations result in a large bandwidth of results. Second,

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differences in methodologies to model long-term global food security can strongly influence the results. Systematic model comparisons in AgMIP showed that structural differences between computable general equilibrium and partial equilibrium, assumptions on technological change, and the way food demand is modelled are important factors which explain differences in model outcomes. Hertel and Baldos (2016) found that apart from technological change, income, capital, labour and land elasticities are critical determining factors of model output, although they only have received very limited attention in the literature. Finally, differences in reporting of results (e.g. definition of variables, units and aggregation) are also an important factor that explains the wide range of outcomes.

The provisional results of our systematic review offer a synthesis of the methods and results of recent global food security assessments. The final set of selected studies shows a variety in terms of methodologies, modelling of driving forces, presentation of food security indicators and range of outcomes. Since the first studies in the beginning of the millennium, modelling approaches have advanced and the latest studies capture a wide number of food security drivers, including, among others, population and income growth, technological change, trade and shifts in diets. It is therefore striking that many drivers are still neglected, such as multiple dimensions of inequalities (beyond income growth), aquaculture, land policy and use, or post-harvest wastage. Indicators that are presented by the modelling studies overlook stability and utilization dimensions of food security. Finally, the range of outcomes is large, even after they are mapped to the same SSPs.

Plausible and implausible global food futures

A cursory look at the food security and food systems debate and a close reading of global food futures studies show that judgments about the plausibility or implausibility of selected futures abound and are rarely explicitly justified. Why is this the case? What is meant by plausibility? Are plausibility judgements indispensable and justifiable or would we be better off without them to set our epistemic, ethical, and political imagination free to explore a broader range of alternative food futures, where for instance, more radical, rapid, and global changes in food production, distribution of land, access to food, modes of consumption, and moral attitudes towards certain foodways would be deemed plausible?

To start answering these questions, we need to look at the function of plausibility in futures studies and its pragmatics, without benefiting from the insights of historians of futures studies who have not yet investigated the evolution of conceptions of 'plausible futures' in depth. Science, Technology and Society scholars, on the other hand, have shown that judgments of plausibility and conflicts about such judgements occur in general during foresight practice and are not reported or explicated in published documents (Van Asselt *et al.*, 2012).

Why is plausibility so important in futures studies, yet often confused with probability or feasibility (Ramirez and Selin, 2014)? In theory, foresight experts converge on the view that the exploration of the future should not be limited to probable futures because complex problems with a long-term temporal scale, such as the evolution of global food systems, generate many futures that it is impossible to forecast. Thus, the main solution is to explore a range of futures more broadly construed than quantifiable probable futures, and more narrowly construed than the set of all logically possible futures: plausible futures.

However, the criteria for characterizing plausibility remains either vague, objectionable, or implicit, ranging from evidence that a similar event has occurred in the past in sufficiently similar circumstances, to proof of concept that some event or process could occur in the future (Wiek *et al.*, 2013). The space between the probable and the possible needs to be charted to expand our imagination about the future, which tends to be anchored to a bias toward certain constructions of the past. But we also want to avoid

idle speculations: credibility and evidentiary support matter. Plausibility judgements have thus played a major role in futures studies at the very least since the work of Herman Kahn on scenarios.

The approach to scenario construction that Kahn, its creator, advocated states that ‘scenarios are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision-points’ (Kahn and Wiener, 1967). Therefore, the job of scenario builders is not limited to presenting images of challenging and relevant alternative futures. Rather, the selection of a set of alternative futures has to be non-arbitrary, inform decisions, and have a heuristic value. To do this, scenario builders ought to expand their imagination and knowledge-base and *causally* explain how we could plausibly get from the present to a small set of challenging, relevant, and distinct futures.

Scenario theorists and practitioners have naturally criticized this influential approach, given well-known philosophical disputes about the meaning and demandingness of causal explanations and notorious practical difficulties in hunting causes in sciences and other social practices. Some foresight theorists and practitioners went beyond raising objections against the exclusive recourse to causal explanations to demonstrate plausibility: they have put forward several alternative approaches. The most influential approach advocates abandoning the requirement of plausibility altogether and argues for a radical pluralistic view according to which both present and future worlds are constructed and do not demand plausible explanations to support them (Vervoort *et al.*, 2015).

Conclusions

To sum up, the broader ethical and political debate about global food futures depends in part on making progress on methods used to explore global food futures, including a combination of modelling and scenarios, and in part on our willingness to discuss the meaning and value of plausibility judgments about considered futures. Should we expand the types of explanations required for providing support to plausibility judgments to include a wider variety of explanations (structural, narrative, etc.) or ought we abandon the concept altogether to avoid judgments that are either epistemically conservative or based on unrecognized ethical, social, and political values?

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