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Food Insecurity: The Future Challenge*

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Abstract At a time where the amount of food produced worldwide is sufficient to feed all, the number of food-insecure people remains high. This article presents an analysis of a number of futures studies on food and agriculture, at both local and global scale, and using quantitative and qualitative methods, with a specific focus on how they frame and address food security. After identifying future key drivers of change, implications for food security are discussed. The results show that futures studies in agriculture are entering into a third generation where key drivers of change include social and political forces as potential sources of discontinuities. It is proposed to move the field of futures studies from the exploration of food security to the exploration of food insecurity, whose multiple roots are anchored in social, political, economic and institutional dimensions, and to focus these future studies on ruptures and discontinuities rather than trends.

Keywords: Food security, futures studies, agriculture, policies, societal values.

1 Introduction

In 2013, at the Special Joint Meeting of the United Nations Economic and Social Council (ECOSOC) and the Economic and Financial Committee (EFC) of the General Assembly on 'food security and nutrition', 11 recommendations were made to address the challenges of hunger and food security. These emphasised the need for an integrated approach to link food security with the three economic, social and environmental dimensions of sustainable development. It was also acknowledged that the 'global food production is sufficient – the world needs to focus on improving access to food and reducing food loss and waste', and advocated hunger eradication as a priority for the post-2015 development agenda (ECOSOC 2013: 5). It is against this background that this article discusses future perspectives for food security through a review of foresight studies in this field.

Futures studies have been defined as 'a trans-/multidisciplinary field of research with a diversity of schools of thought, qualitative and quantitative methods, approaches and applications' (Patokorpi and

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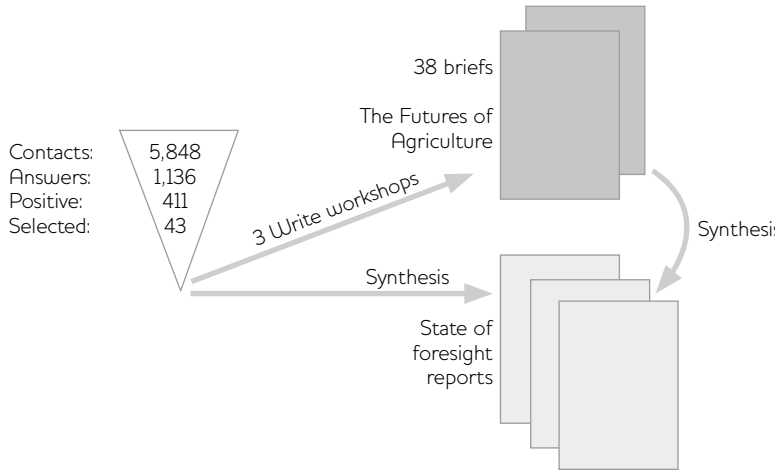
Ahvenainen 2009: 128). Such studies commonly use one of two perspectives: 'explanatory-predictive' or 'proactive-creative' (*ibid*.: 2009: 129). For the purpose of this article a futures study is considered as 'any study that provides a systematic exploration of possible futures'. This definition encompasses a wide range of forward-looking approaches such as projections, forecast, scenario building, foresight and visioning.

The 2nd Global Conference on Agricultural Research for Development (GCARD2) in Punta del Este, Uruguay in 2012, included a session on foresight (Holderness, Palmier and Strange 2013). The objective was to introduce and share experiences with the use of foresight in relation to issues around food and agriculture. Preparation for the session included a review of available foresight studies. This article presents the main findings of that review. Section 2 presents the methods used for the review, and Section 3 presents the results. Implications and suggestions for further research are discussed in the final section.

2 Methodology

Foresight work around food and agriculture was identified by searching websites, identifying and collecting relevant documentation, and through a worldwide survey. The survey was prepared in seven languages and included questions about activities related to the future of agriculture and rural development over a 20-year time horizon. It was administered through a web-based survey provider and invitations to participate were sent to 5,848 organisations or individuals which included all GFAR and Institutional Learning and Change Initiative of the CGIAR (ILAC) partners.[1] The survey remained accessible online for seven weeks and three reminders were sent during this period. The vast majority (93 per cent) of the email invitations were successfully delivered. In total 1,136 surveys (20 per cent) were submitted, of which 620 were complete and

Figure 1 The process



Source Author's own.

Table 1 Titles in the 'The Futures of Agriculture' series

Global studies
Brief No. 01: Sustainable Food Consumption and Production in a Resource-constrained World (SCAR3)
Brief No. 02: A Table for Seven Billion: Six Billion have Enough to Eat – (Only) One Billion to Go (Oxfam)
Brief No. 09: Biofuels and Agricultural Markets: Implications for Food Security (IFPRI Biofuel)
Brief No. 13: Towards Sustainable World Food Systems: Drivers, Key Issues and Research Needs (Dualine)
Brief No. 15: Does Less Meat for Some Mean Cheaper Food for Others? (IFPRI Changing Diets)
Brief No. 16: Exploring the Limits of Food and Farming Systems: The Agrimonde Scenarios (Agrimonde)
Brief No. 17: World Food Supply in a Context of Environmental Change and Increasingly Competing Claims on Natural Resources (PBL)
Brief No. 21: Debunking the Water Scarcity Myth: Understanding Future Water Use Challenges (BFP/CIAT)
Brief No. 38: What are the Likely Developments in World Agriculture towards 2050? (FAO AT2050)
Brief No. 40: What Challenges is Agriculture Facing? Five Scenarios for 2050 (SUAS2050)
Brief No. 42: The Future of Food and Farming (UKForesight)
Brief No. 43: The Livestock–Climate–Poverty Nexus (ILRI)
Regional studies
Brief No. 03: No Foresight, No Food? Regional Scenarios for Africa and South Asia (CCAFS)
Brief No. 05: Foresight Prompts Researchers in Pest Management to Look Beyond Research (Endure)
Brief No. 07: The Future of Rural Europe: Lessons from a Multi-scale Modeling Approaches (Eururalis)
Brief No. 08: Shaping French Transdisciplinary Research Priorities for the Mediterranean (PARME)
Brief No. 11: Food Security in the Mediterranean in 2030: From Foresight to Research Priorities (SAMAQQ)
Brief No. 14: How Might Agriculture Develop in Southern Africa? Making Sense of Complexity (SASP)
Brief No. 19: Evolving Towards a Low-Carbon Society (APEC-LCS)
Brief No. 25: Tres escenarios y un 'trilema' (FONTAGRO)
Brief No. 28: Posibles escenarios para la investigación, la innovación y el desarrollo en los países de Cono Sur (CONOSUR)
Brief No. 31: I'd Rather be Foresighted than Myopic: Foresight Exercises for Agriculture, Food Security, and R&D in Latin America and the Caribbean (LAC_Foresight)
National/local studies
Brief No. 04: Teagasc 2030: Creating Knowledge for Ireland's Bioeconomy (Teagasc2030)
Brief No. 10: Bureau for Food and Agricultural Policy (BFAP): Your Partner in Decision Making (BFAP)
Brief No. 18: Seeking Harmony: Scenarios for Nature Conservation and Agricultural Development in Kapuas Hulu District, Indonesia (CoLUPSIA1)
Brief No. 20: Shaping the Future for Agriculture in Taiwan (Taiwan2025)

cont./

Table 1 Titles in the 'The Futures of Agriculture' series (cont.)

Brief No. 23: Fallen, Wild or Planted? The Future of Thai Agriculture (Thai2020)
Brief No. 26: Preparing for Emerging Challenges to Animal Health in Canada (Fore-Can)
Brief No. 27: A Quarter Century of Forward-looking Policy Analysis (FAPRI-MU)
Brief No. 30: Can Climate Change Affect the Future of Crop Production in Brazil? (SCAF Brazil)
Brief No. 32: El futuro ambiental de una provincia: Mendoza al año 2030 (Mendoza2030)
Brief No. 33: Can Brazil Feed the World? Not Yet, But it has the Potential! (IPEA)
Brief No. 34: Chile agroalimentario, forestal y rural al 2030 (Chile2030)
Brief No. 35: Securing and Building the Future of Quebec Agriculture and Agrifood (Quebec)
Brief No. 36: Building the 5th Strategic Plan of Embrapa 2008–2023 (EMBRAPA5SP)
Brief No. 37: Innovar para un agro colombiano competitivo (AgroColombiano)
Brief No. 39: Building a Shared Vision: Scenarios for Collaborative Land Use Planning in Seram Island, Central Moluccas Regency, Indonesia (CoLUPSIA2)
Brief No. 41: Agriculture 2030: A future for Morocco (Morocco2030)

Source: Author's own.

included in the analysis. This rate of response was considered acceptable given the very specific nature of the survey and the fact that invitations were sent to a broad list of individuals and organisations.

A total of 411 respondents indicated that they had engaged in foresight activities related to agriculture, rural development or farming systems. They were all subsequently contacted and asked to provide documentation of this work. This documentation was screened by a group of 12 foresight specialists drawn from international research centres (4), universities (3), national research centres and organisations (5), and representing eight different countries.

Only studies that met the following three criteria were included in the analysis: (1) the work was recent (published or completed less than five years before the survey); (2) the time horizon of the study was at least ten years ahead; and (3) the core issues related to agriculture, rural development and/or farming systems.

Survey respondents were also asked to identify any other relevant studies of which they were aware. Simultaneously, a multilingual group of interns conducted a literature and web search for additional studies that met the same three criteria.

Altogether 65 studies were identified that met these criteria. Authors of these studies were invited to attend one of three workshops at which they would be assisted to produce a short four-page summary or brief of their study. All the briefs shared a common format covering: content, process, impact and lessons learned. Some authors who could not

Figure 2 Distribution of the case studies according to scale and methods

Qualitative	SCAR3 Oxfam Dualine Agrimonde	CCAFS Endure SAMAQQ PARME SASP APEC-LCS LAC_Foresight	Teagasc2030 Taiwan2025 Thai2020 Fore-Can FAPRI-MU Chile2030 AgroColombiano Morocco2030	CoLUPSIA1 Quebec CoLUPSIA2
Mixed	PBL BFP/CIAT FAOAT2050 SUAS2050 UKForesight ILRI	FONTAGRO CONOSUR	SCAF Brazil IPEA EMBRAPA5SP	Mendoza2030
Quantitative	IFPRI Biofuel IFPRI ChangingDiets	Eururalis	BFAP	
	Global	**Regional**	**National**	**Sub-national**

Source Author's own.

attend a workshop accepted to work remotely on their brief. In total, 38 briefs were produced and published in an open access series called 'The Futures of Agriculture' (Table 1).[2]

The whole process is outlined in Figure 1. The analysis provided in the remainder of this article is based on the 38 briefs.

3 Findings

The scale of the 38 studies ranged from global (12) or regional (10) to national (12) or sub-national (4). The methods used in the original studies, reflecting the nature of the data used and the knowledge generation process, were grouped as either quantitative, qualitative or mixed. Quantitative studies use exclusively methods such as projections, trend analysis and modelling, while qualitative studies use exclusively methods such as exploratory scenarios, Delphi and horizon scanning. Mixed studies combine quantitative and qualitative methods. In total, four studies used quantitative methods, 12 used mixed methods and 22 used qualitative methods (Figure 2).

Analysis of the distribution of key topics addressed by these studies shows that food security was the most important topic at the global and regional scales, while productivity and sustainability are more important at national scale (Table 2).

Drivers are defined as 'factors causing change, affecting or shaping the future'.[3] Analysing drivers is important because it helps understand what forces have been, and could be at play with a potential to transform the current situation into alternative and plausible futures (Godet 1986; Saritas and Smith 2011). Drivers are related to the analysis of the causal

Table 2 **Distribution of topics according to the scale of the studies**

	Topic		
Scale	Food security	Productivity	Sustainability
Global	12 (100%)	7 (60%)	8 (75%)
Regional	5 (40%)	3 (30%)	3 (30%)
National	4 (25%)	6 (40%)	6 (40%)

Note A study may combine different topics.
Source Author's own.

relations behind an observed phenomenon (hunger in this case) and unveil the worldviews on which futures studies are designed by their authors (Inayatullah 1998). In the 38 studies eight clusters of drivers were identified, which are described in turn below.

Climate change: Twenty-two studies refer to climate change as a global constraint to be taken into consideration through adaptation strategies. Nine of them are global studies; seven are regional studies and five are national studies. However, four global studies (Briefs 21, 40, 42, 43), two regional studies (Briefs 11, 19) and three national/local studies (Briefs 23, 30, 34) directly and explicitly integrate climate change as a key driver. Most integrate climate change into their scenarios and analyse its implications for food and agriculture (Briefs 11, 19, 21, 23, 30, 34). A key challenge is coping with increasing uncertainty due to more frequent and unpredictable weather events. In the worst scenarios, major disruptions from climate change reduce agricultural outputs and threaten the lives of the most vulnerable population. Most studies assume that timely corrective actions can prevent or mitigate negative impacts, but such actions will require significant change in policy and social behaviour. The concept of 'no regret' actions (actions which would be beneficial even in the case of no climate change) is proposed in Brazil (Brief 30); while in Asia, it is assumed that greater accuracy of climate modelling due to increased computer processing power will facilitate movement towards a low carbon society (Brief 19).

Demography: Five global, four regional and three local studies give prominence to demography. The most frequently cited issue is population growth (Briefs 07, 08, 17, 21, 38, 39, 40, 41, 42) followed by variables linked to the distribution of population such as urbanisation, migration and density (Briefs 08, 11, 21, 31, 41) and structure of the population, including ageing (Briefs 08, 11, 21, 31). Five studies explicitly take demographic variables as key drivers of change (Briefs 07, 17, 21, 38, 40). The main challenge seen to arise from population growth and distribution is total food availability. These studies also highlight local conditions and dynamics linking demography and food security (Briefs 07, 38, 40).

Trade and markets: Nineteen studies included trade and markets in their analysis. Seven of them (one global, three regional and three

national studies) used trade and market as drivers of change (Briefs 07, 16, 25, 36, 28, 41). They highlight the role of regulation, such as trade and market barriers, in shaping future food security. These studies converge around scenarios that contrast future trade regimes: a liberal world led by global market forces; a world of global trade regulated by international institutions; and a world of regional or fragmented trade and markets. They all consider that deregulated trade would threaten sustainability and increase food insecurity and inequality. Some studies explore strategies related to the evolution of global trade. For example, the study by FONTAGRO concentrates on a more competitive, efficient and sustainable family agriculture based on links with markets and better knowledge flows, better use of natural resources and adaptation to climate change (Brief 25). In the Morocco study, three scenarios of trade regulation were developed and led to the design of the 'Plan Maroc Vert'. This plan is based on two pillars for agricultural development: the first pillar supports the integration of agricultural and agro-industrial firms in the world economy while the second seeks to modernise a small-scale agriculture based on solidarity, and supported by public intervention linking local entrepreneurship and community development (Brief 41). In the Agrimonde study, an economic growth scenario is opposed to an ecosystem preservation scenario. However, the conclusion is that in both scenarios food trade will remain necessary to secure regional food needs, and that global food security in 2050 will be primarily a matter of food access as opposed to food availability (Brief 16).

Income and growth: Four studies cited income or economic development and growth as key drivers of change (Briefs 07, 13, 31, 40). The key linkage is how economic growth drives change in consumption patterns, with potential ramifications throughout the food system. The Dualine case study states that 'when incomes increase we observe an increase in calorie consumption, then an increase in the share of calories from animal products and then stabilisation' (Brief 13). Economic growth and rising income can be associated with different outcomes. On the one hand, global food security improves, but on the other, nutrition and health problems such as obesity are on the rise. Income distribution is also critical: although production might increase enough to satisfy global needs, there is no guarantee that food insecurity will be abated.

Technology: Five global, four regional and six national studies included technology as a driver of change. They mainly take technology in a broad sense (Briefs 09, 16, 21, 25, 28, 40, 41). For example, in some studies intensification under a productivity paradigm is contrasted with agroecology or ecological intensification (Briefs 16, 25, 28). The Agrimonde study suggests that food security can be achieved through an alternative paradigm of ecological intensification, while the Morocco study suggests that different technological paths are needed to support different farming systems. However, most studies also link shifts in the technology paradigm to a shift in societal values and policies, so that food security and sustainability are not necessarily in tension. This is highlighted in Brief 09 which suggests that new generations

technology may reduce negative impacts of biofuel production on food security. However, the case of the river basins in Brief 21 shows also that technology must be considered in a wider context of potentially conflicting objectives and trade-offs (e.g. a dam for hydro energy threatening fishery and rice production).

Some of the studies address the question of farming systems with the future being characterised by a divide between technology and capital-intensive systems, often at large-scale, and ecologically-oriented systems, often associated with small-scale, family-based agriculture (Brief 17). The first type is associated with trends towards more concentrated commodity production for mass consumption. The second takes different forms according to the location (small-size family farming in regions where people are poor and levels of education are low, where farming can play an important role in the economy and social life – Brief 41), or hobby or part-time farming for a more diversified consumption and/or niche markets. Interactions between different types of farms are also highlighted leading to the question: how can different farms coexist in the same geographic and economic space (Brief 02, 03, 08, 41)? Indeed, many studies consider the possibilities of alternative futures with different ways of farming, providing insights on potential evolution and challenges (Briefs 02, 03, 04, 05, 17, 23, 41) or priorities (Briefs 20, 36, 41) for farmers and future farming patterns.

Consumption patterns: In 13 studies, change in food consumption is explicitly considered as a driver of future production patterns and food security. Of these, eight consider consumer behaviour as a global driver, with most highlighting the trend towards the standardisation of Westernised consumption patterns with more animal proteins and higher calorie intake (Briefs 01, 15, 38, 42). Change in consumption patterns is related to other drivers such as income growth and urbanisation (Briefs 13, 38). Policy is seen as having a crucial role through its potential to influence food consumption patterns (Brief 01). Waste and loss management emerges as an area where policy can influence both production and consumption. Some studies suggest possible ruptures where food demand becomes more regional and diversified, and where dietary patterns could evolve in contrasted ways, including a possible decrease in the consumption of animal protein and healthier more diversified diets (Briefs 01, 15, 16, 42). Two studies suggest that convergence of dietary patterns is not inevitable (Briefs 13, 38).

Policy: Policy is presented as a key driver of change in 30 studies. In the national studies it is presented as one of the two axes of uncertainty used to build scenarios of the future of agriculture in Southern Africa (Brief 14) and in Thailand (Brief 23). It is also one of the six drivers on which scenarios for nature conservation and agricultural development were built in Kapuas Hulu district, Indonesia (Brief 18). Several policy variables were combined to build scenarios for collaborative land use planning on Seram Island, also in Indonesia (Brief 39). National trade policy is the main driver of the three scenarios in the case of agriculture

in Morocco (Brief 41). Policy is also constitutive of the axis on the national environment for research, development and innovation in the scenarios used to build the 5th Action Plan of Embrapa in Brazil (Brief 36). Most studies consider policy as a driver of change towards non-trend scenarios, or as a potential factor of discontinuity. That policy matters is thus not just a general statement; some of the studies go deeper and suggest how policies can shape the future. These include, for example, governance and cooperation styles such as the respective role of state and non-state actors (Brief 03), or power relations (Brief 40).

Societal values: Twelve studies include societal drivers of change, such as values, behaviour (excluding consumer behaviour) and education. Seven studies take a national or local perspective, and highlight the importance of social values in preparing for emerging challenges to animal health (Brief 26), evolving towards more sustainable use of resources (Briefs 19, 32), land use planning (Briefs 18, 39), building scenarios for research or development (Briefs 28, 41). These studies show how important societal drivers are for food security and sustainability, and that food and agriculture cannot be dissociated from their socioeconomic and cultural environment. As stated in Brief 21, food security 'is not about food, it is about peoples' lives'.

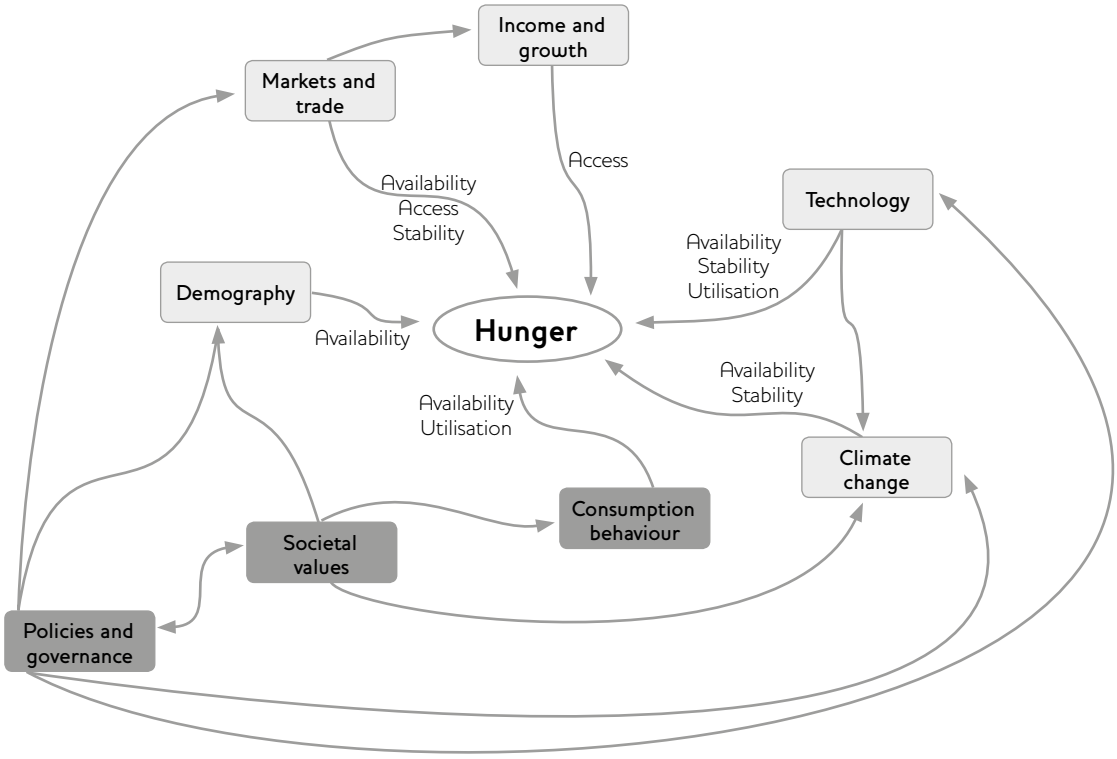
4 Discussion and implications

Figure 3 shows how the drivers highlighted in the studies are linked to hunger. These foresight studies suggest a strong association between food security and climate change (i.e. changes in temperature, rainfall and frequency of climatic hazards compared to the past) and demography (i.e. changes in the number and distribution of people on earth) (Khan *et al.* 2014; Reilly and Willenbockel 2010; Beddington *et al.* 2012; Vervoort *et al.* 2014). The studies also show a strong tendency to highlight policy and governance as key drivers; indeed policy and governance are increasingly considered not just as part of the solution but also as part of the problem. Consumption patterns and societal values are emerging from this inventory as new drivers of change (de Haen and Réquillart 2014).

These observations resonate with other work which suggests an evolution in the focus on futures studies through three stages (Georghiou and Keenan 2006; Georghiou 2003): technological forecasting; integration of technology and markets; and integration of technology, markets and social dimensions.

Although food security is widely recognised as encompassing four dimensions – availability, access, utilisation and stability (FAO 2009) – availability continues to dominate debate (Khan *et al.* 2014; van Dijk and Meijerink 2014). Yet, several global studies and most of the regional and national studies reviewed here emphasise the importance of access to food. In this sense they are in line with other foresight work on food security (de Haen and Réquillart 2014; Hubert *et al.* 2010). Indeed, others acknowledge that 'global food security is not only about producing enough food for the world's population. Questions of access

Figure 3 Drivers of hunger highlighted in the briefs



Note Drivers indicative of 1st and 2nd generation studies are in light grey boxes, while those associated with emerging drivers indicative of 3rd generation studies are in dark grey boxes. Connecting arrows represent influences as highlighted in the case studies. Arrows linking drivers with hunger are labelled with regards to the four dimensions of food security each driver is directly affecting (food availability, food utilisation, food access and food stability).
Source Author's own.

need to run alongside those of availability' (The Royal Society 2009). The most recent version of FAO's Outlook 2050 indicates:

> Based on our assessment of world agricultural resources, it seems that at the global level there should be no major constraints to increasing agricultural produce by the amounts required to satisfy the additional demand generated by population and income growth to 2050 (Alexandratos and Bruinsma 2012).

The core issue is that, while there is enough food currently produced to feed the world's population, around 1 billion people today remain food-insecure (Ingram 2011). What might happen to them in the future has not yet been explored.

I argue that foresight studies should now systematically address the question of accessibility. To do this the focus must evolve from global food security, with its implicit emphasis on quantities, production, productivity and technology, to the question of food insecurity and its implicit focus on poverty, redistribution and social inequity.

The emergence of policy, social and behavioural drivers in foresight studies is to be welcomed. Indeed, many previous foresight studies, especially those focused on technology, concluded with policy recommendations but they saw policy as an external factor. As a result, these recommendations were of limited relevance to policy processes. In most recent foresight work, policymakers and a greater number of stakeholders more generally are now no longer seen as simply end users. Foresight on food security, agriculture and rural development is entering what foresight scholars have coined the third generation of foresight (Georghiou and Keenan 2006). Third generation foresight adds a social perspective to the traditional technology and market perspectives; social factors and behaviour are becoming major drivers of change (Cachia, Compañó and Da Costa 2007). This resonates with earlier findings on the futures of the food system, highlighting the inclusion of changes in political, social and economic processes (Erb *et al.* 2009).

The recognition of the importance of societal values, social behaviour and policies also highlights the need for foresight approaches that integrate local perspectives. These questions were not ignored in foresight studies reviewed here, but as a majority of these studies used modelling approaches they were constrained in their ability to grapple with issues such as rights, power and institutions. Clearly there is an important role for mixed methods approaches which will allow the exploration of disruptive scenarios.

5 Conclusion

The 38 futures studies reviewed in this article were selected through an open process and met three simple criteria. Their scale ranged from sub-national studies to global studies and they are based on a diversity of approaches and methods.

The analysis of these studies casts some light on possible new orientations for foresight studies in relation to the challenge of hunger. Specifically, the future of the populations who are food-insecure today is not just bound to the total amount of food that will be available in the future. Policy, cultural values and individual and collective behaviours have the potential to disrupt today's undesirable paths, which are driven by demographic, climatic and economic trends.

This is a call for foresight studies that can help support a fundamental re-thinking of the global food system. It is a call for reflection on societal choices related to how and by whom food will be produced and consumed. A shift from focusing on food security to food insecurity, and from technology to people, institutions and society, and a more systematic inclusion of the local dimension will allow foresight studies to be more relevant to the transformative agenda that is integral to the Sustainable Development Goals.

Notes

* The author wishes to express his recognition to all the colleagues who contributed to the screening and selection of the relevant case studies from more than 400 source documents, as well as all the authors who have accepted to write the briefs. The inventory would not have been possible without the support of the Institutional Learning and Change project, and in particular Javier Ekboir, Christian Sette and Cedric Egal, as well as the seven interns who have contributed to the web scanning of relevant foresight studies. I extend my gratitude to Mariana Wongtschowski and Gerald Baltissen, the facilitators of the write workshops where the briefs were produced. This work would not have been completed without the financial support of the French Ministry of Foreign Affairs. I dedicate this work to the memory of Dr Enrique Alarcon, who so kindly accepted to accompany us during this process in Latin America but could not see its results.

1 For more on the survey and respondents, see www.egfar.org/sites/default/files/files/Report_Inventory.pdf. GFAR = Global Forum on Agricultural Research. CGIAR = Consultative Group on International Agricultural Research.

2 www.gfar.net/information-gateway/. Search 'The Futures of Agriculture' in the search engine to access the briefs.

3 Source: http://bit.ly/FTPglossary.

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