Linking multi-actor futures for food systems and environmental governance

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Abstract

The food systems/global environmental change nexus is a key area of research that links two major interconnected challenges humanity faces in the 21st century. This paper discusses the role of strategic foresight for tackling these challenges in spaces that aim to facilitate deliberative, multi-actor governance. First, we reflect on the role of foresight in the domains of global food futures and global environmental change and its impacts on governance in these domains. Then, we explore how lessons from both domains can be integrated by examining an on-going international foresight program: the CGIAR program on Climate Change, Agriculture and Food Security (CCAFS). Using multi-stakeholder scenarios interacting with global market/water/land cover models, this program explores trade-offs, synergies and other relationships between food security and environmental governance in the developing world. The CCAFS foresight process takes a complex systems approach, exploring the inter-connectedness of food systems and environmental systems. This systems approach includes the acknowledgement that diverse sources of knowledge and experience are crucial both to systems understanding and to concerted action toward sustainable and accepted change. Key to the CCAFS foresight process is the ambition to go beyond a disconnected futures process and to integrate foresight into the daily realities of multi-actor governance. We discuss how well the CCAFS foresight program connects food systems and environmental change futures and whether it succeeds in integrating strategic foresight in both governance dimensions. Based on this case we outline challenges and opportunities for foresight in the food systems/environments nexus.

Introduction

The food systems/global environmental change nexus is a key area of research that links two major interconnected challenges humanity faces in the 21st century. The complex challenges and trade-offs relating to food insecurity and environmental change in the developing world demand collaborative action by diverse actors across system dimensions (biophysical, economic, policy, temporal) and levels (local, regional, global) (Cash et al. 2006; Ericksen et al. 2009; Vervoort et al. in press). Interacting human and natural systems and their contexts are constantly changing, as are stakeholder groups and interests operating within them (Folke 2006). This generates irreducible and dynamic uncertainty which confounds attempts to develop linear and unilateral policies (Funtowicz and Ravetz 1993; van der Sluijs 2005). It requires state and non-state decision makers to look beyond adaptation oriented to single stressors such as climate change. Instead, decision makers have to co-manage change along continuously adaptive pathways, attending to diverse and shifting contextual challenges while proactively aiming for dynamic goals such as improved food security and environmental sustainability (Stafford Smith et al. 2011). To play a relevant role in such sense- and decision-making processes, research needs to employ a systems perspective that is attentive to changing interactions across system dimensions and levels (Cash et al. 2006; Ericksen et al. 2009). This type of research should involve stakeholders holding different and often contesting types of expertise, experience, values and interests (Gibbons 1999). It can facilitate exchange by co-creating boundary objects that span boundaries between various stakeholders (Jasanoff 2004; Kristjanson et al. 2009; Clark et al. 2011; Chaudhury et al. 2012).

This paper discusses how strategic futures work through scenarios and back-casting can help sense– and decision-making in multi-stakeholder contexts to navigate the interacting challenges of food security and environmental change. To this end, we first introduce what we mean by multi-stakeholder futures. We then discuss the role of multi-stakeholder futures on the issue of environmental change, and similarly examine such processes in the context of food security. Following a comparison of practices around these issues, we discuss a process facilitated by the CGIAR research programme on Climate Change, Agriculture and Food Security that seeks to link food security and environmental change and actors involved in these issues at the regional (sub-continental) level through multi-stakeholder futures work.

Multi-stakeholder futures

A wide range of methods exists for futures research and are applied to a wide range of issues and across sectors, including both global environmental change and agriculture and food security. Computer model-based forecasting involves projecting a continued interplay of historical trends into the future and often strives towards assigning probabilities to the subsequent range of future outcomes. Plausibility-based scenarios, by contrast, seek to maintain an open future and operate as reframing rather than forecasting devices (Kok et al. 2006a; Wilkinson and Ramirez 2010).

There are many different ways to build plausibility-based scenarios and the design of the scenario process rests on several factors, including the client(s) and purpose of the intervention (van Notten et al. 2003; Van der Heijden 2005; van Vuuren et al. 2012). Scenarios are a means and not an end, but rather part of a wider intervention. Purposes vary from sense making, through decision support to conflict avoidance and resolution. Futures methodology can combine different methods e.g. participatory scenarios, integrated assessment models, visioning and back casting, to engage the multiple legitimate perspectives and interests involved in framing and addressing today's significant messy challenges (Wilkinson and Eidinow 2008). More linear sense- and decision-making processes that do not incorporate multiple scenarios still have underlying assumptions about the future, effectively operating from a single scenario that is not examined. This failure of traditional planning to engage with uncertainty has proven to be problematic when actors are operating in complex systems (van der Sluijs 2005).

Scenarios development can provide spaces for actors with diverse sources of knowledge and experience, and potentially with opposing interests and agendas, to explicate their views, learn from each other and develop a shared language and understanding (Wilkinson and Eidinow 2008). Because actors' stakes in the long-term future are less defined than stakes in the present, the future offers a vital space for conflict and revealing underlying myths and beliefs that are implicit in framing problems and legitimising actions, can empower a requisite variety of perspectives and enable more options to be considered (Wilkinson and Ramirez 2010).

However, since scenarios deal with actors' contexts rather than directly with their strategies, they do not offer a direct method for adaptive decision making. To be able to get to collaborative adaptation pathways, the scenarios should be used in strategic processes that are specifically aimed at generating pathways of policies and actions. Back-casting, or

backwards planning, is such a method (Kok et al. 2011; Robinson et al. 2011). Back-casting starts with a desired, normative goal and then works out what needs to be happening before that goal is achieved, and the successive steps that are needed until the present is reached. The result is a pathway from a desired future to the present that highlights short- and mid-term actions that are needed. The advantage of back-casting is that it takes strategic planners away from planning forward into the future in a linear manner, an approach that can lead to plans that build on the past rather than for a dynamic and uncertain future. Back-casting has been used by Kok et al. (2011) and Robinson et al. (2011) in conjunction with scenarios. By combining the two methods, the strength of scenarios (exploring the challenges and opportunities offered by plausible futures) is combined with the goal-based approach of back-casting to explore what adaptive pathways need to be realized to improved conditions in each of the alternative scenarios and what the major obstacles and opportunities are in each future world.

In this way, the scenarios act as alternate future contexts in which different adaptation pathways can be developed and tested under different plausible and dynamic future conditions that each offer distinct challenges and opportunities as the back-casting pathways develop through them (Figure 1). The combination of scenarios and back-casting becomes a tool for exploring adaptation pathways that are also dynamically goal-oriented and not limited by a reactive stance. Through the combination of scenarios and back-casting, shared knowledge developed by multiple stakeholders in the scenarios can be used to develop new, collaborative adaptation pathways and test their feasibility (Kok et al. 2011). The process can also guide priority setting, providing enabling conditions for such adaptation pathways (Stafford Smith et al. 2011). Importantly, the combination of scenarios and back-casting is a process that can help build collective strategic capacity. New partnerships can emerge as collective adaptation plans are made.

Multi-stakeholder futures in the context of global environmental change

Multi-stakeholder futures work, specifically in the context of scenarios, has been applied in a wide range of environmental assessments. Many of the environmental assessments that included scenarios work were done at the global level; there are also many examples of national and sub-national assessments as well as some regional examples where scenarios work was used. Van Vuuren et al. (2012) and Wilkinson and Eidinow (2008) each provide insightful overviews of the use of scenarios in environmental assessment.

Vuuren et al. (2012) focus on global environmental assessments that involved scenarios processes. They point out that a multiple futures approach forms a key element in many global environmental assessments because of the need to explore the long-term effects of near-term actions. They point out that in the context of complex interactions between human and natural systems prediction is often not possible.

The Limits to Growth report of the Club of Rome played an important role of introducing scenarios to environmental science (Meadows 1972), though their projections were not yet labelled "scenarios" and did not have a play the role of an interaction space between stakeholders. Building on this beginning, in the last 15 years there has been an increasing role for scenarios in global environmental assessments such as the IPCC (Nakicenovic 2000), the Global Environmental Outlook reports by UNEP (UNEP 2007), the Global Scenarios Group's work on Great Transitions (Gallopin 2002) and the Millennium Ecosystems Assessment (Millennium Ecosystems Assessment 2005).

The first distinction Van Vuuren et al. (2012) make is between scenarios and forecasts, observing that all major global environmental assessments have used plausible scenarios rather than attempting to forecast the future. Secondly, the authors distinguish between probabilistic versus deterministic scenarios. Probabilistic scenarios aim to specify the probability of different trends by attaching probability-distribution functions to input parameters. This approach has not been used in global environmental assessments because many of the drivers discussed in these assessments are unknown at a fundamental level where probabilities cannot be assigned. Deterministic scenarios, in contrast, describe specific, concrete futures that span the space of uncertainty as far as the stakeholders participating in the process have scoped. A third distinction made by van Vuuren et al. (2012) is between process and product orientation. They state that in contexts where there is a distinct client or group of clients who may be directly involved in the scenario work, the process may be seen as more important than the product, but since many global environmental assessments are developed for a very diffused audience, they tend to focus on the product. The IPCC work is a particular example of a largely expert-driven and product-oriented process.

The distinction between product and process also relates to the need or willingness for the process designers to engage with a broad diversity of stakeholders. Because of the broadness of most intended audiences in global environmental assessments, these processes often feature review moments of the scenarios rather than co-development. This relative lack of

participation has been seen as a weakness of scenarios work in global environmental assessments. Their development by relatively small groups of largely environmental scientists, largely limiting the presence of social scientists while describing future changes relevant to social science expertise, has limited their scope. More broadly, the lack of participation by other sectors limits their logics to those present in academia. Another distinction to be made is the extent to which scenarios processes have used qualitative and quantitative methods. Most global environmental assessment scenarios combine these two elements to some degree. Storylines provide the logic for alternate futures, and can be useful to translate the scenarios to different contexts and generally to engage audiences. Quantification through modelling helps provide scientific rigour (dependent on the quality of the models and available information about causal relationships and data). However, there is an imbalance between the social science underpinning the scenario narratives and the greater time and effort put into the quantification of the environmental dimensions of the scenarios in most global environmental assessments. A key problem with environmental change models is that they are largely unable to quantify discontinuities in systems and are limited to smooth trends (van Notten et al. 2005).

Scenarios can be either explorative, describing what "could" happen, or normative, describing desired futures of what "should" or "should not" happen and that explore the implications of policy interventions. Van Vuuren et al. (2012) show that most scenarios in global environmental assessments before 2005 have been exploratory scenarios, while those from after 2005 have been normative scenarios, reflecting a need for more policy relevance but arguably losing the benefits of the explorative approach. Both versions of scenarios have been used in global environmental assessments. Scenarios can also be "back-cast" from defined futures and then linked back to the present, or "forecast" from a set of imposed rules from the base year on.

An distinction between scenarios in global environmental assessments that is especially relevant for the global environmental governance perspective is whether scenarios are used to "speak truth to power", providing clear answers and legitimizing policies, or as an "arena" to stimulate debate between multiple stakeholders.

There are strong differences in the degree the global environmental assessment scenarios are linked to policy processes. The IPCC scenarios are directly linked to the UNFCCC process.

In the Millennium Ecosystems Assessment, the link to international policy was less clear and the role of governments was less defined. Another example is the UNEP Global Environmental Outlook which is principally target to UNEP as the funding organisation but also indirectly seeks to connect to a wider audience of member states.

Due to pressures to be credible to a wide range of audiences, most global environmental assessment scenarios do not involve surprises or extreme futures, which leads to criticism of these scenarios not exploring a broad scope of uncertainty

Van Vuuren et al. (2012) argue that many global environmental assessment scenarios overlap and that in fact "scenario families" can be identified that capture many aspects of similar scenarios across the assessments. Because of the weaknesses of scenarios work in global environmental assessments mentioned previously (lack of stakeholder inclusion, under-representation of social science expertise) this observation that the scenarios largely fall in these scenario families is worrying. It indicates that together the global environmental assessment scenarios capture a certain scope of the future without offering much diversity. This worry is exacerbated by the reality that many scenarios processes in global environmental assessments build on previous, similar efforts.

Wilkinson and Eidinow (2008) argue that environmental assessment scenarios have been limited by what they label "problem-oriented" scenarios approaches. Seeing scenarios as a tool to reduce uncertainty about the future through sophisticated modelling limits the ability of these processes to play a role in deliberative governance models. Wilkinson and Eidinow offer the alternative that is prominent in scenarios use in the business world, where scenarios processes have a very distinct client (the company) and involve that client in the scenarios development to "re-perceive" their context and thereby come to new insights and strategies (Wilkinson and Eidinow 2008). However, they argue that the multi-stakeholder deliberative governance needed to begin to tackle environmental issues should incorporate and go beyond both the "problem-oriented" and "actor-oriented" models. Offering a new model which they describe as "reflexive interventionist multi actor" scenarios (RIMA), they argue for a much more reflexive process that engages new groups of actors dynamically through new iterations of futures exploration, allowing these new actor groups to critically question the assumptions of previous scenarios, and using the scenarios process as a way for various actors to explicate and discuss their own fundamental assumptions about the world, as well as those of others.

Multi-stakeholder futures in the context of agriculture and food security

A recent study by the GFAR Global Foresight Hub (Bourgeois et al. in preparation) has aimed to collect and analyse a wide range of futures work in the context of agriculture and food security. The project selected 43 case studies on global, regional, national and local levels in this context that it deemed were most relevant to explore and compare more in-depth. We will base our overview of the use of multi-stakeholder futures in the context of agriculture and food security on this inventory. It is relevant to note that the CCAFS scenarios process that is the focal case study in this paper was also part of the inventory.
More than half of the cases described in the inventory is concerned with futures exploration for sense-making. A minority of the cases is primarily interested in impacting priority setting and policy change. Capacity building and networking are the most minor objectives, being mentioned as objectives in only 2 and 3 cases, respectively.

In contrast to the environmental assessment scenarios sets, Bourgeois et al. show that the futures work related to agriculture and food security offers some major differences and controversies, and does not fall so easily in a set of "scenario families".

Just as in environmental assessments, there are distinctions between scenarios processes in agriculture and food security in terms of the presence of quantitative and narrative elements. While qualitative assessments using narratives have been done across all levels, quantitative analyses are more prevalent at the global level.

In contrast to the environmental assessments, a number of cases in the GFH inventory stress the importance of interdisciplinary exchange and the use of futures work to experiment and hold constructive debates among stakeholders. Together with these aims comes the interest in working with top-down and bottom-up approaches simultaneously. The higher presence of inclusivity in the agriculture and food security cases also relates to a need to combine quantitative and qualitative, narrative-based enquiry. However, despite the higher ambitions for inclusivity, in reality many futures processes in this context involved relatively few people – global futures efforts mostly included less than 50 participants in their processes. A more mixed-method, inclusive picture emerges in comparison to global environmental assessments that is nonetheless dominated by researchers in international organizations,

academia and government institutes in developed countries, and, at the global level, is dominated by quantitative analysis.

Impacts of futures processes in agriculture and food security have mainly been identified as raising awareness and fostering debates beyond the participants in the work, helping stakeholders develop new links amongst themselves and contributing to the developments of methods, internally and externally. Beyond this, direct impacts on internal (e.g. organizational) and external policies due to the futures work have been reported in several cases. Awareness-raising was reported to have happened due to the provocative or challenging nature of the outcomes of processes. Cases that had such impacts all had a quantitative dimension to their results. Direct policy impacts were largely reported when the work was commissioned by a decision-maker. Most of these cases were conducted at a national or at the most regional (e.g. sub-continental) level.

In analysing this collection of futures studies in the context of agriculture and food security, Bourgeois et al. (in preparation) highlight a number of improvements in these types of processes. These improvements came out of a series of interactions between members of the Global Foresight Hub's Forward Thinking Platform, where representatives of 30 of the 43 case studies participated, including authors of this paper. These participants concluded that futures work in agriculture and food security should focus more on how impacts can be made with decision-makers, both in terms of tools and methods (linking visions to actions, for example) and in terms of processes (including decision-makers in the future explorations). ICT was seen as a key potential area to be explored to up-scale the engagement of key participants across sectors. This links to the recognition that a greater level of inter-institutional and inter-sector collaboration is needed to open explorations up to new insights and capitalize on available knowledge. There is a capacity building dimension to this need for linking and bridging that would involve more training in futures methods.

Using multi-stakeholder futures to link deliberative governance around agriculture, food security and environmental change

Global environmental change in the forms of climate change, loss of biodiversity, land degradation and changes in hydrology is impacting food security and the expectation is that this impact will grow in the future (Ericksen et al. 2009). Similarly, agriculture impacts

environmental change, e.g. through land conversion, eutrophication and emissions. To tackle the interconnected challenges of present and future food security and environmental change, deliberative sense –and decision-making methods are needed that enhance understanding and enable more adaptive policies. As discussed in the contexts of environmental change on the one hand and agriculture and food security on the other, multi-stakeholder futures processes have the potential to facilitate such sense– and decision-making processes. However, as both sections have shown, current activities in these contexts with regard to futures work have some limitations.

Global environmental change scenarios incorporate agricultural developments and even include food security and consumption, sometimes to a significant extent. Agricultural production is largely seen through the lens of "use of natural resources". In contrast, agriculture and food security scenarios and other future projections feature environmental change consequences somewhat less prominently and incorporate less dimensions, especially when processes operate from a largely technocratic, production-oriented perspective.

Most research linking global environmental change and food systems focuses primarily on the impact of climate change on agricultural production, or the impact of agriculture on problems around land conversion and use, pollution and biodiversity. Other aspects of food systems such as processing, distributing and consuming food are largely overlooked (Ericksen et al. 2009).

Importantly, groups of stakeholders linked to environmental change and stakeholders linked to various aspects of food systems have largely not interacted in futures-oriented arenas.

A notable exception has been the GECAFS scenarios process that was specifically built on a new definition of the food system (Ingram 2010). Regional scenarios were developed for the Indo-Gangetic Plain and the Caribbean with an interdisciplinary group of experts. These scenarios were linked to the Millennium Ecosystems Assessment – which demonstrates their explicit link to environmental change scenarios. This scenarios process was largely focused on collaborative sense-making and did not feature an explicit policy planning element. As a sense- making process, it produced insights specifically revealed by the combination of global environmental change knowledge and its inclusive perspective on food systems (Ingram 2010). The scenarios work in GECAFS provided the basis for further and more

extensive work for the CCAFS program, our case study for using scenarios to link global environmental change and food security futures.

Case study: regional scenarios for the CGIAR climate change, agriculture and food security program

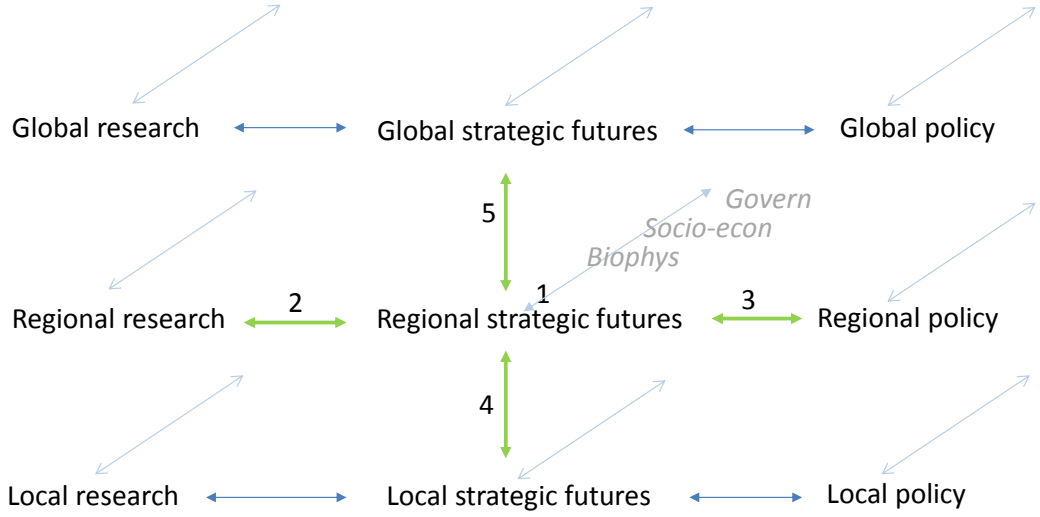
The CGIAR research program on Climate Change, Agriculture and Food Security (CCAFS) is a global alliance that engages in a range of research, capacity building and policy guidance activities focusing on climate change adaptation and mitigation pathways across food system dimensions and levels in the developing world (Vermeulen et al. 2012). Within the CCAFS program, sub-continental multi-stakeholder futures processes employing scenarios and back-casting methods are being undertaken in different sub-continental regions in the developing world (East Africa, West Africa, South Asia). These multi-stakeholder futures processes are designed to help support adaptive sense- and decision-making under future uncertainty. The CCAFS regional scenarios process builds on previous experience from the GECAFS project. This includes the express focus on food systems rather than just agricultural production, and a strong link to environmental change scenarios.

This systems approach includes the acknowledgement that diverse sources of knowledge and experience are crucial both to systems understanding and to concerted action toward sustainable and accepted change.

In the CCAFS scenarios process, we aim to learn from the challenges and limitations found in both the environmental assessment futures work and in the futures experiences in the context of agriculture and food security. We will first outline the basic elements of the process and discuss some results. In the discussion, we will evaluate to what extent we are in the process of successfully bridging futures work in environmental change and food systems, and to what degree we are able to tackle some of the challenges identified in the reviews of both of these fields.

The CCAFS strategic futures process links research and policy and across system levels (Figure 2) through five distinct interactions:

1. The development of regional scenarios with actors across sectors, based on an exploration of key regional uncertainties;
2. The quantification of the regional scenarios through research formalized in models and other means that link stakeholder-driven assumptions and their effects (e.g. through technology, government support, infrastructure) for food security and environmental change;
3. The use of the scenarios as decision contexts for deliberative governance at a regional level;
4. The translation and use of the scenarios as decision contexts local level planning;
5. The use of the regional scenarios process as a case study to link to global strategic futures such as the IPCC Shared Socio-economic Pathways (Moss et al. 2010).



1 Multi-stakeholder regional scenarios development

The first aim in the scenario development process is to capture key drivers and uncertainties at the regional scale with key regional actors in policy, the private sector, civil society, the media and epistemic communities and explore their consequences for future food security and environmental change. The scenario sets in each region are structured along the two drivers that are seen by regional actors as both highly relevant and highly uncertain – but many other key drivers feature across all scenarios. The scenarios mainly focus on socio-economic uncertainties and are used as complementary to climate scenarios. Initially, climate change was treated the same across all scenarios, given the relative certainty around this driver up to 2030 perceived by stakeholders based on estimates from Jones and Thornton (2009). More recently and based on new stakeholder feedback across the regions, we have revised this process to develop scenarios that run up to 2050 which allows a combination

between multiple climate scenarios and socio-economic scenarios, along the lines of the new IPCC framework (Moss et al. 2010) though with a different scope.

Self-evaluation of outcomes of the scenarios process in East Africa suggests that initial benefits of the process are perceived by most participants as: learning new skills and insights; better understanding of concepts around future uncertainty and complexity, including the difference between projections and forecasts and plausible scenarios; and a clear idea of how scenarios could be used in adaptive strategy development for food security and environmental management. Since part of the self-reporting was done some time after a scenarios development workshop, a number of participants were reporting that they went on to use scenarios in their own planning processes. These stakeholders reported that they thought the scenarios content as well as process address criteria of saliency, credibility and legitimacy deemed critical for linking science to policy (Cash et al. 2003).

2. Quantification of the scenarios through integrated agricultural products market and land cover change models

Once regional stakeholders had developed qualitative story lines that describe plausible, alternative futures, these scenarios were modelled to allow quantification of key outcomes and indicators. Different agricultural economic modelling tools are being used to do this, particularly the IMPACT (Rosegrant et al. 1995) and GLOBIOM (Havlík et al. 2011) models. These are both global partial equilibrium models, but they have different strengths and weaknesses. IMPACT is designed to examine alternative futures for global food supply, demand, trade and prices, while GLOBIOM is designed to provide policy advice on global issues concerning land use competition between major land-based production sectors and the conversion of natural land. GLOBIOM also models emissions from land use change. While IMPACT and GLOBIOM are global models, they are being modified to enable specific regional applications to be simulated.

In East Africa, the scenarios were quantified to inform the model drivers based on semi-quantitative assessments from stakeholders. Preliminary results from the two models were discussed with representatives of the regional stakeholder group who provided feedback after which some changes were made to make the model results more plausible for the region. The models yielded significant but plausible differences between the scenarios and between the

two sets of model outputs and a number of insights for the region. After presenting the model results in subsequent workshops, participants thought the model results were "were tangible and practical" and that they felt the outputs would be useful for "planners and decision makers seeking legitimate information before making choices", requesting detailed information on the model results to take back to their organizations and ministries. However, impacts of the subsequent use of model information in these contexts are yet to be measured and require more time.

An important avenue for making the scenarios more relevant for adaptive decision-making is the link between short-term variability and long-term change in socio-economic and biophysical drivers. Short-term price spikes and market volatility present considerable challenges for food security, not least because of their interactions with longer-term trends; the same is true for short-term climate variability and longer-term progressive change. Adaptive decision-making has to tackle challenges generated by changes on these interacting time resolutions – all the more reason for a reflexive and dynamic futures process that attends to both. The CCAFS regional scenarios are attempting to address the interactions between these time resolutions. The interactions of the process with local-level analysis allow this complementarity to be stronger still. But while qualitative scenarios can feature both short-term changes and longer changes over their time lines, when scenarios are quantified, models usually address either to long-term changes or short-term variability. Efforts are being made to overcome this division: a version of the GLOBIOM model is under development that will allow the CCAFS regional scenarios to be quantified in relation to the impacts of short-term variability in economic drivers as well as longer-term trends (Fuss et al. 2011).

3. Using the scenarios for strategic planning with regional state and non-state actors

Our experience with engagement with both non-state and state actors in separate workshops, corroborated by participants' evaluations, is that they were successful in enhancing the abilities of the participants to think more strategically about future adaptive pathways, as well as start to grasp more fully the cross-sectoral and cross-country dialogues and partnerships urgently needed to tackle regional food systems and food security issues. For example, an

environmental officer of the East African Community (EAC) took the following messages into the budget planning meeting that followed the scenarios workshop:

- Failure of governments to invest in food security and the environment would have severe negative long-term consequences on both, as played out in the "Herd of Zebra" scenario – she recognized that this particular scenario was in fact the one that current national policies were leading towards.
- As long as governments within the regions failed to work closely with private sector and civil society actors, they would continue to have a limited ability to initiate positive change, such as enhancing regional food security.

It became clear, however, as with many engagement processes, that investing in an organization that continued to facilitate boundary spanning activities (Clark et al. 2011) between researchers, civil society, private sector and public sector actors would be critical to turn some of the ideas generated into actions, such as new partnerships, initiatives, institutions, and policies (Selsky and Parker 2005). This is referred to by Reid et al. (2009) as the "continual engagement model". It is also apparent that workshops (over several days) are not an effective approach for engaging the high-level actors – in both the private and public sectors – who are in the best position to turn the ideas generated into actions: they are simply too busy and the incentives to engage are not clear to them. So a key role of the boundary organization playing this role (the Society for International Development) supported by the CCAFS strategic futures process will be to continue to strengthen the partnerships and turn the ideas from both state and non-state actors into actions. Examples include a plan to increase the voice of the East Africa Farmers Federation in agricultural and food security policy processes; developing a partnership plan between agriculture ministries, government meteorological offices and regional media to develop new climate and weather information communication outlets in the region; develop exchange visits between East African agriculture ministries, and farmers' schools and associations and link to researchers working on climate analogues; setting up a permanent scenarios/strategic futures unit that reports to the EAC and provides continuous strategic insight at the regional level in the way that the CCAFS scenarios process has done. Strategies such as breakfast meetings between the boundary organization, participants willing to act as policy champions and higher-level policy makers are being pursued. Additionally, a range of innovative communication outputs with regional communication and media specialists (cartoons, briefs, blogs, films, TV

episodes) are being created. A specific avenue we are exploring is the development of a simple on-line application, linked to mobile phone technology, that allows a wide linkage of actors across food systems and linked to environmental change issues to communicate with simple messages about the future of food security and environmental change in their regions.

4 Linking regional and local strategic futures

The CCAFS multi-stakeholder futures process is being linked to a range of local strategic futures activities within and outside the program. The interaction between the CCAFS regional scenarios and local-level strategic futures works both ways: regional scenarios can inform local adaptation pathways, and outcomes can be used to inform and enrich the scenarios and, by extension, regional adaptive pathways.

5 Links to global environmental and food systems futures

Several links between the multi-region futures process organized by CCAFS and partners and global futures work are being developed, both with environmental change scenarios as well as with global futures on agriculture and food security. The IPCC-led scientific community is in the process of finalised a set of five global Shared Socio-economic Pathways (SSPs), complementary to new climate scenarios or Representative Concentration Pathways (Moss et al. 2010). With the global community reaching out, the CCAFS scenarios could also be an invaluable input to the process of translating the global climate change scenarios to the regional level. Part of the CCAFS futures team is also involved in the development of the IPCC SSPs which makes this parallel process feasible. The CCAFS scenarios developed for East Africa, developed separately from the SSPs, nonetheless fit their framework well while offering more regional tensions, challenges and opportunities not perceived at the global level.

In the dimension of agriculture and food security, the CCAFS scenarios process has been used by the Global Foresight Hub as an example of multi-method futures work and to help conceptualize different foresight approaches for the future of food and agriculture. The Forward Thinking Platform of the Global Foresight Hub plans to help CCAFS develop its futures processes by drawing on the collective experience of the network, and additionally to

ensure the visibility and use of outcomes in the global food and agriculture foresight arenas (Vervoort and Ericksen 2012).

Discussion and conclusions

This paper has highlighted the need for futures-oriented exploration, through scenarios and back-casting, of food systems and environmental change futures. We have first discussed the current state of global environmental change scenarios processes as well as scenarios processes in agriculture and food security. Though our comparison is not totally symmetrical because we mainly looked at environmental change scenarios at the global level while looking at agriculture and food security scenarios across levels, we can conclude that there is a similarity tendency at the global level in both topic areas not to engage with stakeholders and to focus heavily on quantitative modelling. Agriculture and food security scenarios processes do offer more diversity in this regard than environmental change scenarios processes. This could be related to the nature of the topic and the associated disciplines. Both agriculture and food security and global environmental change processes are highly interlinked and very much core activities of global actors. However, environmental systems have a history of being perceived as the context of human activities, in the form of resources or affected natural environments and biophysical systems. Importantly, though, is that while both environmental scenarios on the one hand and food security scenarios on the other have elements of the other in terms of subject matter, truly interdisciplinary analyses are rare. This is most clearly the case with regard to the engagement of actors from both of these topic areas in multi-stakeholder scenarios.

This paper mentioned the GECAFS project as an exception where global environmental change and food security scenarios were connected in a multi-stakeholder context. Building on the experiences in this project, the CCAFS scenarios process was set up, discussed here as a case study.

The CCAFS scenarios process attempts to link agriculture, food security and environmental change at the regional level in multiple developing world regions. This includes bringing stakeholders from both topics together, and modelling some aspects of the trade-offs between environmental change governance and food security and agriculture. The emphasis in this scenarios process has still been somewhat more on agriculture and food security than on the

environment, in the sense that the first topic area has been explored in a more multi-dimensional way while environmental change has been limited to fewer indicators and descriptions of environmental change dynamics - such as biodiversity loss, land use change, emissions, ecosystem services. A way to have equal and appropriate multi-dimensionality for each inter-connected topic area that the CCAFS scenarios process is exploring is to develop more collaboration with the environmental change community through the Future Earth program, in terms of participatory processes but also in terms of modelling and quantification. The CCAFS scenarios program is attempting to go beyond some of the limitations identified in this paper that are associated with scenarios work both in environmental and agriculture and food security contexts, by involving a wide range of stakeholder groups and disciplines through different, appropriate processes, and through linking across geographical levels. However, the risk of such inclusiveness affecting the possible depth of inquiry in specific sub-topics has to be managed.

Our conclusion is that if express attempts are made to overcome current limitations of scope, balance and inclusivity in current scenarios processes, there is strong potential for scenarios to play a central role in developing integrated systems-perspectives for sense– and decision-making for multi-actor governance of environmental change, agriculture and food security.

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