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Scenarios to explore global food security up to 2050: Development process, storylines and quantification of drivers

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TO EXPLORE THE FUTURE OF GLOBAL
FOOD AND NUTRITION SECURITY

Scenarios to explore global food security up to 2050: Development process, storylines and quantification of drivers

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Abstract

To guide policymaking, decision makers require a good understanding of the long-term drivers of food security and their interactions. Scenario analysis is widely considered as the appropriate tool to assess complex and uncertain problems, such as food security. This paper describes the development process, storylines and drivers of four new global scenarios up to the year 2050 that are specifically designed for food security modelling. To ensure the relevance, credibility and legitimacy of the scenarios a participatory process is used, involving a diverse group of stakeholders. A novel approach is introduced to quantify a selection of key drivers that directly can be used as input in global integrated assessment models to assess the impact of aid, trade, agricultural and science policies on global food and nutrition security.

Keywords: Scenarios, food security, participatory scenario building, integrated assessment.
JEL codes: Q18, O13, C53

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1 Introduction

The question on 'how to feed the world in 2050' has received increasing attention from policymakers, the media and scientists since the surge in food prices in 2007/2008. Understanding long-term food and nutrition security is a complicated issue, since it is determined by the interaction of a wide number and highly uncertain drivers that operate at the household (e.g. income and education), national (e.g. agricultural and social protection policies) and global (e.g. climate change and trade policy) levels (see Laborde et al., 2013 for an analytical framework).

Due to the complex nature of food security, it is not surprisingly that projections for global food production, food prices and food security indicators (e.g. undernourishment and child malnutrition) differ widely across studies. For example, according to the FAO (Alexandratos and Bruinsma, 2012 p. 7) global food production needs to be increased with 60 per cent in 2050 (compared with 2005/2007) to feed the global population, while Tilman et al. (2011) find that an increase of 100-110 per cent is required. Similarly, a review of 12 global scenario studies (Dijk van and Meijerink, 2014) finds a highly diverse range of projections for food prices (ranging from 18 to 973 US$ per ton for maize, 86 to 771 US$ per ton for paddy rice and 41 to 708 US$ for wheat); undernourishment (ranging from 2.8 to 6 percent of global population) and child malnutrition (ranging from 50 to 189 million children) in 2050. The review concludes that the outcomes are difficult to compare due to differences in (1) assumptions on scenario drivers; (2) design of the models that are used to generate food security indicators and (3) reporting of results.

Scenarios are a useful tool to guide decision making in case of so called 'wicked problems' (Wilkinson and Eidinow, 2008). Wicked problems are public problems that are characterized by a high level of complexity, uncertainty and systemic challenges that impact across local to global scales. They are seemingly intractable because the influence of many social and political actors as well as biophysical factors (Rittel and Webber, 1973). Wicked problems are described as 'messy' because there is no consensus on what is exactly the problem. The consequence is that different perceptions of stakeholders will lead to diverse and often opposing definitions of the problem. Wicked problems are, therefore, not easily tackled with traditional linear planning approaches that are based on historical and empirical evidence. Participatory scenario building and modelling offers an alternative approach that is better suited to deal with complex interactions and uncertainty, while at the same time addressing and integrating the different views of stakeholders. Apart from this, it has been demonstrated that scenarios can also support linking science and policy (Chaudhury et al., 2012) and guide action (Vervoort et al., 2014). Scenario analysis has become the standard approach to assess climate change, ecosystems and biodiversity but only recently emerged as a tool to assess global food security (e.g. Dorin and Paillard, 2009).

This paper describes the development process, storylines and drivers of four new global scenarios up to the year 2050 that are specifically designed for food security analysis and modelling. It is part of the FP7 FOODSECURE project, which aims to assess global food and nutrition security by means of scenario analysis and modelling. The FOODSECURE storylines and drivers presented in this paper will be quantified by means of a number of well-known global integrated assessment models.[1] The models will also be used to assess the impact of aid, trade, agricultural and science policies on global food and nutrition security.

The structure of the paper is as follows. Section 2 presents brief background information on the definition of scenarios and possible scenario types. Section 3 describes the methodology that is used to derive the storylines and related quantified drivers. It explains some of the methodological choices such as the type of scenario, the stakeholder engagement process and participatory approach, and the method to quantify important drivers. Section 4 presents the results, including the four scenario storylines and figures of main drivers. A discussion of the process and outcomes is given in Section 5, followed by conclusions.

2 Scenarios: definitions and types

Over the last decade, scenario analysis has increasingly been applied as a tool for dealing with the complexities and uncertainties associated with the impact and development of major global interrelated issues such as climate change, food security and land use. Scenario analysis has served as the core methodology in major integrated assessment studies of international institutions, i.e. the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Environmental Programme (UNEP), as well as national and regional level assessments.

A number of definitions has been given for scenarios in the literature. The Millennium Ecosystem Assessment defines scenario as “plausible and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions on key driving forces and relationships” (Carpenter et al., 2005). Scenarios provide a means of dealing with complex and uncertain issues such as future global food security, which depend on the interplay of a large number of driving forces. Scenarios have been useful in helping policy-makers to think about how the future might unfold and guide the formulation of policies that are dependent on future expectations. A common approach in large global integrated assessments is to develop creative storylines, often using participatory methods with stakeholders that are subsequently modelled to analyze the relationship between drivers and quantify the impact of policies. There is a long history of using scenario analysis in climate and environmental studies, but it is only recently that this approach is being used to assess future food and nutrition security.

Several typologies have been proposed to group scenarios in the literature (e.g. van Notten et al., 2003). Borjeson et al. (2006) (but also see Berkhout et al., 2002; and Reilly and Willenbockel, 2010) provide a typology based on the three principal questions that users may want to pose about the future: What will happen?, What can happen? and, How can a specific target be reached? These questions translate into a typology of three major classes of scenarios that deal with probable, possible and preferable future states, respectively.

[1] Three different models (combinations) will be used to quantify the scenarios: (1) MIRAGE (International Food Policy Research Institute, IFPRI), (2) GLOBIOM (International Institute for Applied Systems Analysis, IIASA) and (3) MAGNET-IMAGE (LEI Wageningen UR and the Netherlands Environmental Assessment Agency, PBL).

The first class, or *projections*, include baseline scenarios that describe the future state of a system with no policy changes. They are also referred to as 'business-as-usual' and 'reference' scenarios. Baseline scenarios are mostly used as a reference point to examine how a system changes when a number of 'what-if' assumptions has been made. Projections involve a certain degree of probability, or likelihood in their construction. The analysis is centered on one single scenario – the baseline – which is assumed to describe the future. Usually, projections do not assume changes in the structure and boundary conditions of the system and therefore might fail to capture major transformative change, novelty or surprises. Projections are best used for planning to analyze foreseeable changes and evaluate policy shocks in the medium term (10-20 years). Often the emphasis lies on quantification of results.

The second class, or *explorative scenarios*, are designed to give room to 'out of the box' thinking; they typically involve the development of a set of rich narratives that describe possible polar worldviews. To facilitate easy communication and discussion of multiple futures, scenario practitioners tend to work with a set of four scenarios that are formulated along two, relatively independent, high impact and highly uncertain dimensions of the system. The four scenarios can then be compared using a matrix in which the dimensions form the axes. Scenarios often cover multiple decades and sometimes centuries, and allow for changes in the structure of the system and boundary conditions. The emphasis lies on qualification of scenarios, although many recent studies combine storylines with modelling to quantify outcomes. The picture of different futures is particularly useful to guide strategic decisions or inform policies in situations of rapid and irregular change, when the future is difficult to predict. Explorative scenarios can be used to analyze and compare the impact of policy decisions in the context of different futures.

The final class, or *normative scenarios* are designed to support vision building. They involve the creation of stories or pathways that meet specific outcomes or targets, for example the description of a future that is desired or should be avoided by all means. Backcasting is used to identify the pathways and decision points to reach a specific vision of the future. The time horizon for normative scenarios is usually beyond 25 years.

3 Methodology

This section describes the methodology, which is used to develop the scenarios. After a short discussion on the choice for the type of the developed scenarios and the participatory approach, it elaborates on the stakeholder engagement process and the methodology to quantify key drivers.

3.1 Type

On the basis of the scenario typology described above, we decided that the exploratory scenario type is the most appropriate tool to assess future global food security. As we are mainly interested in the long-run view (up to 2050), using projections with only a single baseline scenario to represent the future does not seem appropriate. The exploratory scenario approach - which defines four polar future worlds - is better suited to capture the high level of uncertainty and complexity involved in an assessment of long run global food security. Similar to exploratory scenarios, normative scenarios are also designed for long run assessments.

However, because of their backward looking approach, they cannot easily be used to assess the impact of present policy shocks on future changes. The main goal of the FOODSECURE project is conducting impact analysis and assessing trade-offs between several policy domains that affect food security (e.g. trade, aid, environmental and technology policies). Exploratory scenarios in our view are better able to do this than normative scenarios.

3.2 Stakeholder participation

Alcomo and Henrichs (2008) present four criteria to evaluate the quality of scenarios: (1) relevance; (2) credibility; (3) legitimacy, and; (4) creativity. All four criteria are related to the need for participatory stakeholder engagement, in particular in cases where scenarios are created for policy makers and other non-scientist end users. Since the prime aim of the FOODSECURE scenarios is to support policy making in the food security domain, it is important that the scenarios fulfill the four quality criteria. For this reason, a strong participatory approach has been adopted to guide the design of the storylines and inform the quantification of drivers. The specifics of the drivers for food and nutrition security are outlined in the two following sections.

3.3 Scenario development process

The Stakeholder Integrated Research (STIR) approach, which has recently been applied and tested for the development of climate change scenarios (Gramberger et al., 2014) is used to guide engagement with the various stakeholders in the scenario development process. STIR consists of the following five features (Figure 1):

Participatory integration of stakeholders in the research process. The aim of STIR is to make stakeholder engagement an intrinsic part of the scientific project and to create useful outputs that can be applied by the scientific community and stakeholders alike. To this end, STIR promotes an iterative process between stakeholders and scientists in which dialogue and co-creation of knowledge are central. This is different from a consultative process in which stakeholders are asked for feedback on research without participating in the creation of outcomes themselves.

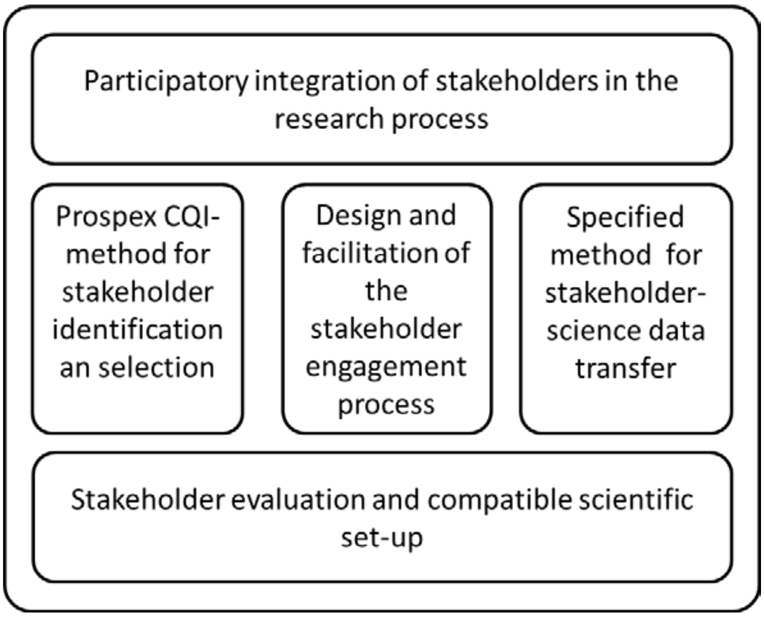
Prospex CQI-method for stakeholder identification and selection. To optimize the stakeholder engagement process, STIR stresses the need for a process to identify and select stakeholders. One approach to organize such a process is the Prospex CGI-method that consists of: (C) Defining a set of criteria and categories for stakeholder groups that are influencing the topic of research or are affected by it; (Q) Setting a specific minimum quota for all kinds of categories (i.e. affiliation, gender and nationality), and; (I) Identifying individuals that fit the categories.

Design and facilitation of the stakeholder engagement process. To establish a dialogue between stakeholders and scientists, stimulate co-creation of knowledge and promote a truly participatory process, STIR emphasizes the need for detailed process design (i.e. designing the participatory process before the start of the engagement process) and professional process facilitation (i.e. ensuring that all stakeholders participate equally and that the desired outcomes are obtained on time).

Specified method for stakeholder-science data transfer. To use methodologies that ensure the data created by stakeholders (often qualitative) is usable in the scientific analysis (often quantitative). In the context of scenario development, STIR often applies the Storyline-And-Simulation approach (SAS) (Alcamo, 2008a), which links qualitative scenario development with quantitative modelling through a number of iterative steps.

Stakeholder evaluation and compatible scientific set-up. To ensure direct and measurable feedback, stakeholders are asked to evaluate the scenario building process, preferably by means of written anonymous surveys after each activity or workshop. A compatible scientific setup means that stakeholder engagement processes are organized in such a way that they can be easily linked to the scientific research, for example organizing separate stakeholder engagement processes for each region that is analyzed.

Figure 1: Stakeholder Integrated Research (STIR) features



Source: Gramberger et al. (2014)

The basis for the development of the FOODSECURE scenarios were two two-day workshops and two webinars (Table 1), during which a participatory process was organized with stakeholders to create the four FOODSECURE scenarios. The stakeholders were selected using the CQI-method to ensure that the background of stakeholders was balanced. The workshops brought together around 20 different stakeholders, drawn from international organizations (e.g., OECD and FAO), national institutions, the EU, international non-governmental organizations (e.g., Oxfam and Action contre le Faim), universities and the private sector. The stakeholders comprised policy makers, researchers, experts in scenario analysis and high level representatives from business with an interest in food security issues. The workshops were professionally designed and facilitated following the STIR approach by a company specializing in stakeholder engagement processes. The same stakeholders were invited for both workshops to ensure continuation of the process. In some cases, new participants from the same organizations replaced previous ones, if those were unable to attend the second workshop. At the end of each workshop, all participants were asked to fill out a questionnaire for evaluation.

The process to develop the scenarios consisted of the three main steps: (1) the development of the scenario logic and storylines, (2) the quantification of key drivers, and (3) the validation of results. For the first step, the participants were organized in groups and asked to come up with a list of key driving forces and uncertainties that influence global food security. Throughout the workshops, participants stayed in the same scenario group, which enabled them to become 'experts' in their scenario. The selected key drivers included: population growth, technical change, lifestyle and consumption patterns and income inequality. During group discussions, the list was used to select the two axes that define the scenario logic. The storylines were further developed in subsequent rounds of structured assignments and group work followed by plenary sessions for discussion. The results were subsequently used as a basis to quantify several key drivers required as an input into the models (see below for more information).

After the two workshops, the scenario support team refined the storylines and assigned numerical values to the projections for a number of key drivers. To validate the results, two webinars were organized, which made it possible for stakeholders to comment on the scenario narratives and quantification of the drivers. The recommendations from the stakeholders were incorporated in the last version of the scenarios.

Table 1: Overview of FOODSECURE stakeholder workshops and webinars

Event	Date and location	Participants	Main activity
Workshop 1	5-6 September 2013, Bruges, Belgium	19	(1) Qualitative scenario development
Workshop 2	27-28 February 2014, Prague, Czech Republic	16	(1) Finalization of storylines (2) quantification of key variables
Webinar 1	6 June 2014, online	2	(1) Validation of storylines (2) validation of quantification of key variables
Webinar 2	10 June 2014, online	8	(1) Validation of storylines (2) validation of quantification of key variables

Source: Authors.

3.4 Quantification of scenario drivers

To assess global food security and analyze the impact of policies, the scenarios will be numerically assessed by means of economic and biophysical models. These models have global coverage and therefore require a large amount of information on several exogenous driving forces and parameters. The most important are projections for population growth (also including urbanization), economic development and technological change (i.e. agricultural productivity in terms of crop yield).[2] Several approaches have been proposed in the literature to 'translate' stakeholder-proposed storylines into numerical series (van Vliet et al., 2010). A frequently used approach in the development of climate change scenarios is "fuzzy set theory" (Alcamo, 2008b; Kok et al., 2014), in which scenario trends are first described in linguistic form by stakeholders, and then a translation key is used to derive numerical values. The disadvantages of fuzzy set theory is the requirement of prior expertise and knowledge to propose realistic values for the drivers and parameters, needed by the models. It is therefore difficult and costly to apply fuzzy set theory in practice. For this reason, we applied a novel approach to derive the future trends of main drivers, which we term 'participatory trend mapping'.

3.4.1 Participatory trend mapping

In workshop 2, after the first draft of the scenario storylines was finalized, stakeholders were asked to discuss future trends of key drivers consistent with the proposed narratives. In particular, scenario groups were asked to graphically illustrate the trend of the six key drivers up to 2050.[3] Each group was given a set of figures that depict the historic trend of the drivers over the last five decades (see Figure 2a for an example). As the development of drivers is expected to differ across different types of countries, historical information was depicted for four different income groups using the World Bank classification: high income countries ($12,616 per capita or more), middle income countries ($1,036 to $12,615 per capita), low income countries ($ 1,035 per capita or less) and BRICS.[4] By means of these figures the stakeholders obtained a broad idea about past trends. Next, the stakeholders were asked to continue the trend line up to 2050 for each of the drivers in such a way that they are consistent with the scenario storylines, but at the same time are still realistic compared to the historical developments (see Figure 2b). This exercise stimulated the scenario groups to re-evaluate the scenario consistency, resulting in meaningful discussions and - on some occasions - a revision of the scenario storyline.

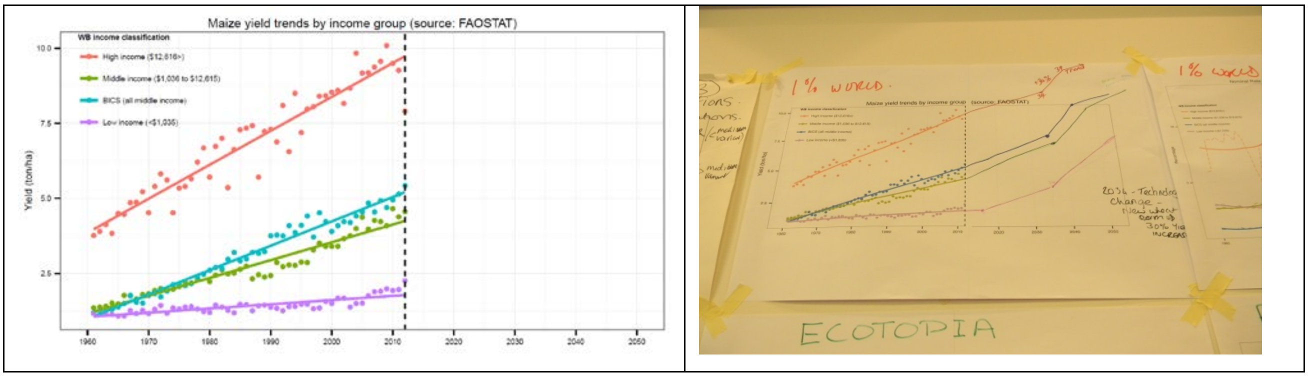
[2] Other drivers and parameters that are needed are, among others, change in consumer preferences, trade tariffs, biofuel directives and land use parameters. On the basis of the scenario storylines, these variables can be quantified, but this is still work in progress. In a next version of the paper a table will be added which also presents information on these variables per scenario.

[3] Population growth, GDP per capita, cereal yield, nominal rate of assistance, meat consumption and land use. The decision was made to use GDP per capita instead of GDP for the participatory trend mapping exercise because this measure is easier to compare across countries and therefore easier to grasp by stakeholders. GDP projections are then calculated as the product of GDP per capita and population projections.

[4] In practice, historical trends were presented for the BICS countries, excluding Russia because it was not possible to construct historical series for Russia before 1989, when the USSR dissolved. We do not expect this has had any impact on the trend mapping by stakeholders. In the final quantification of the drivers, Russia was considered as a BRICS country.

Figure 2: Example of participatory trend mapping for the Ecotopia scenario

(a) Trend (b) Projections by stakeholders



3.4.2 Estimation and extrapolation of trends

The diagrams with the stakeholder trends for each of the drivers – together with qualitative information from the storylines – formed the basis for the actual quantification of the drivers performed by the research team. Depending on the driver, several approaches have been used for the quantification:

GDP and population growth. Consistent and realistic GDP and population projections cannot simply be created by extrapolating existing trends, but rather require certain historical patterns and theoretical assumptions to be considered. For example, in case of population growth, projections need to take in to account present demographic structures, migration and education (UNDESA, 2012). In case of GDP growth, long-run studies on historical growth demonstrate that countries exhibit patterns of "catching up, forging ahead and falling behind" (Abramovitz, 1986; Maddison, 2001; Fagerberg and Verspagen, 2002), strongly depending on the rate of innovation at the technological frontier and the capacity and speed with which lagging countries are able to absorb new technologies and catch up. Constructing high-quality projections is therefore a complex, costly and specialist undertaking. For this reason, we decided not to create new projections, but instead to build on, and extend, the quantification of drivers from previous scenario studies. This is not an uncommon approach, and it has also been used, for example, by Westhoek et al. (2006) to prepare scenarios for the assessment of land use change in Europe. The existing projections are subsequently combined with the trends, as proposed by the stakeholders to arrive at the final dataset.[5]

Our main source of scenario projections for GDP and population are the recently completed Shared Socio-economic Pathways (SSPs) (Kriegler et al., 2012; O'Neill et al., 2012). To create the projections for the FOODSECURE scenarios, we compared the SSP storylines and projections for GDP per capita and population with the FOODSECURE scenarios and trends proposed by the stakeholders to identify similarities and discrepancies. It proved to be relatively straightforward to match both scenario studies on the basis of the broad narrative. Nonetheless, as would be expected, important differences remain between the FOODSECURE and SSP scenarios that need to be taken into account. In particular, the assumptions on

[5] In the near future the database will be accessible through the FOODSECURE website.

population growth for several scenarios and country income groups differ substantially. On the other hand, GDP per capita trends are very similar between the comparable SSP and FOODSECURE scenarios.

To bring the SSP projections for GDP and population in line with the FOODSECURE narratives, the SSP trends where re-scaled up- or downwards, depending on the storyline. In most cases SSP2, or the Business-as-usual scenario, was taken as a reference. Different scaling factors were used for each of the four country income groups. Finally, the projections for GDP per capita and population are combined to derive the GDP series at the country level.

Crop yield and livestock feed conversion efficiency. The SSPs do not provide projections for crop yield and livestock feed conversion efficiency growth, the indicators that are normally used to model technical change in crop and livestock sectors in global assessment models. Therefore, a different approach was used to construct projections for these indicators. Crop scientists, who analysed long-term historical crop yield patterns, have pointed out that yield growth generally exhibits a linear trend (Fischer and Edmeades, 2010; Hafner, 2003). In a recent article, Grassini et al (2013) investigated past yield trends of 36 regions and concluded that "yield projections based on linear models, with breakpoints and plateaus to reflect the linear nature of the crop yield gains" (Grassini et al., 2013 p. 9) should be used to derive future food production projections. Nonetheless, in previous assessments, modelers tend to use compound growth rates to construct yield projections, which will result in too optimistic scenarios (Grassini et al., 2013; WRI, 2013).

We incorporated the recommendations of crop scientists, and used linear instead of compound growth rates to project a baseline for future yield of eight crop groups. The baseline was combined with breakpoints and plateaus to model the introduction of radical technologies (sharp rise in yield) and dramatic impact of climate change (sharp decrease in yield) that were proposed by the stakeholders in several of the scenarios. The results are presented in the next section.

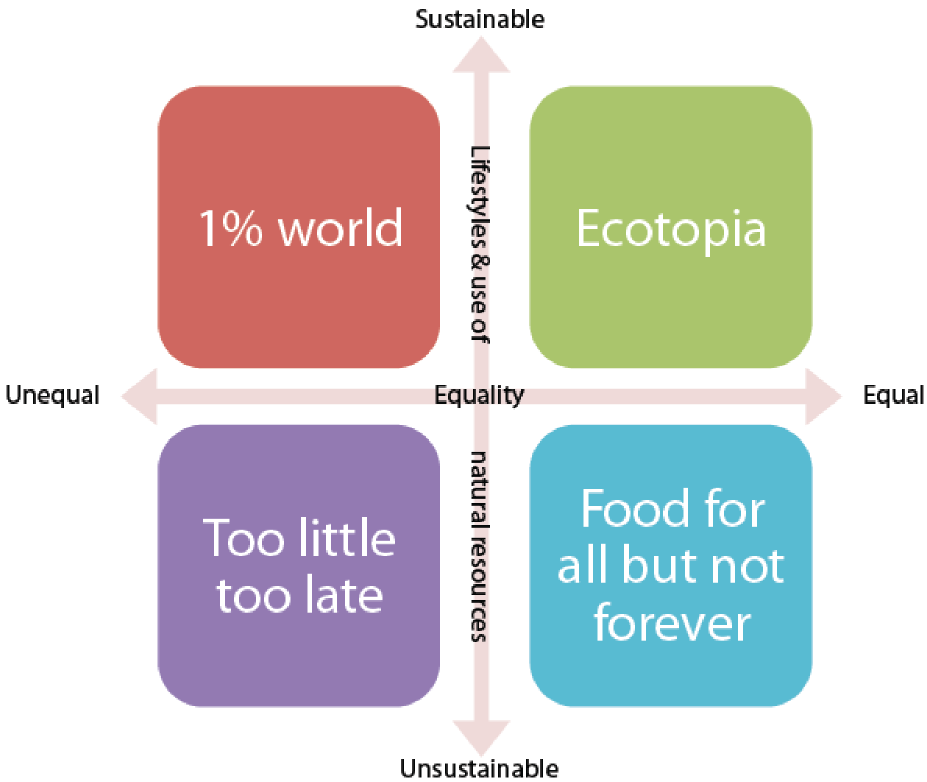
In contrast to crop yield, there is much less information available on the past and future trajectories of livestock feed conversion efficiencies (e.g. Bouwman et al., 2005; Wirsenius et al., 2010), which are defined as the amount of feed required by per livestock category (e.g. dairy, ruminant meat, pork and poultry). For the FOODSECURE scenarios we use livestock feed conversion efficiencies from INRA/DLA (2012), which are computed for three livestock sectors (cattle, pigs and poultry and dairy cattle). Historical projections are inferred from the mass balance of the global food system by means of the Agricultural Representative Identity based Pathways and Emissions (AgRIPE) framework combined with findings from Bouwman et al. (2005). A Business as Usual scenario for feed conversion efficiencies is generated by the GLOBIOM model up to 2050 that is in line with FAO projections (Alexandratos et al., 2006). We decided to use this scenario for all four FOODSECURE scenarios, since the projections are based on biophysical ceiling values which are unlikely to increase.

4 Results

4.1 Scenario logic

Figure 3 shows the four FOODSECURE scenarios and their position in the scenario matrix. The stakeholders decided to organize the scenarios around two axes that highlight two major uncertainties: (1) lifestyle and use of natural resources ranging from a sustainable to an unsustainable world and (2) equality, with the two polar views of an equal and a highly unequal world. Together, they define for different scenarios: *1% World (ONEPW)*, *Ecotopia (ECO)*, *Too little, too late (TLTL)* and *Food for all but not forever (FFANF)*. The storylines of the four scenarios are summarized below. All scenarios describe a world in the year 2050 and particularly mention the state of food security.

Figure 3: Scenario logic of the FOODSECURE scenarios



4.2 Storylines

4.2.1 1% world (ONEPW)

In the *1% world*, global wealth is very unequally distributed. An elite group of 'new rich' – that constitutes around one per cent of total population – controls the major corporations dominating the majority of markets and owning most of natural resources. The greater part of the resources, in particular water and land, is located in developing countries. The scarcity of resources in these countries has increased considerably over the past forty years. Authority and power are shifted from the government to the elite. Governments have cut budgets and reduced the expenditures in public services, which are mostly replaced by private services, mainly geared towards the needs of the elite. The elite are highly educated and trained. To protect their assets, they invest in research and development to create private solutions for global environmental problems. The results of the investments are a number of path-breaking technologies to overcome the problems of climate change, reduce pollution and waste and protect the environment. Other technological advances have resulted in much higher crop yield to ensure the efficient and low-cost production of food. A lot of the advanced technology put in place requires minimum skill levels from employees handling the technology. The food and nutrition security is ensured for the elite in the 1% world scenario. The rest 99% of people are fed, since the quantity of food has been provided through high efficient and technologically advanced production systems. However, the nutritional quality of the staple food is insufficient, especially regarding micronutrients.

4.2.2 Ecotopia (ECO)

The *Ecotopia* scenario assumes an equal society, in which all people are well educated and wealth is equally distributed. Free movement of people is guaranteed. Local policies support development of rural areas. New agricultural production technologies are developed that focus on sustainability and zero waste. Urban agriculture is highly developed and aquaculture is sustainable. New and diversified renewable energy sources are applied, which replace conventional fossil fuel energy sources. Environmental and agricultural innovations are accessible for everybody due to their open source nature. Trade policies are aligned to food and nutrition security and stable ecosystems. The global population has access to sustainable diets. Water and food choices and basic needs are covered. All food is safe and there are new sources of food available and socio-cultural aspects are respected in the diet. The concept of "prosumers" is introduced, where consumers of food are at the same time also producers of food. In the Ecotopia scenario therefore the problem of food and nutritional insecurity has been solved by 2050.

4.2.3 Food for all but not forever (FFANF)

In the *Food for all but not forever* scenario consumption and growth are more important than sustainability in the mindset of the global population. The rapid economic and employment growth, accompanied by more intensive multilateral international co-operation, has led to free movement of goods and people, better health and education systems, more democracy and eradication of hunger. Wealth is more equally distributed and poverty has been reduced, since countries have adopted taxation systems to equalize incomes and property within societies. At the same time, the environment is on the brink of catastrophe. The climate change problem has worsened: over the last years, the global economy has been severely suffering from climate-induced disasters, such as hurricanes, floods and droughts. This happened as a consequence of the use of more and cheaper fossil fuels and less renewable resources, as well as due to the shift to intensive, but polluting agricultural systems. The overuse of pesticides and fertilizers has substantially decreased soil fertility on all continents across different ecosystems. The rainforest has largely been destroyed and replaced by farm land. Food production systems have intensified to the point that pandemics have broken out in the livestock sector. Food and nutrition security is this scenario has been achieved, but in an unsustainable way (i.e. overintensification of food production systems). On global level, the problem of malnutrition has been solved, as well as micronutrient deficiencies (due to government interventions). However, the shift to synthetic food was a necessary measure resulting from the collapse of natural food production systems.

4.2.4 Too little, too late (TLTL)

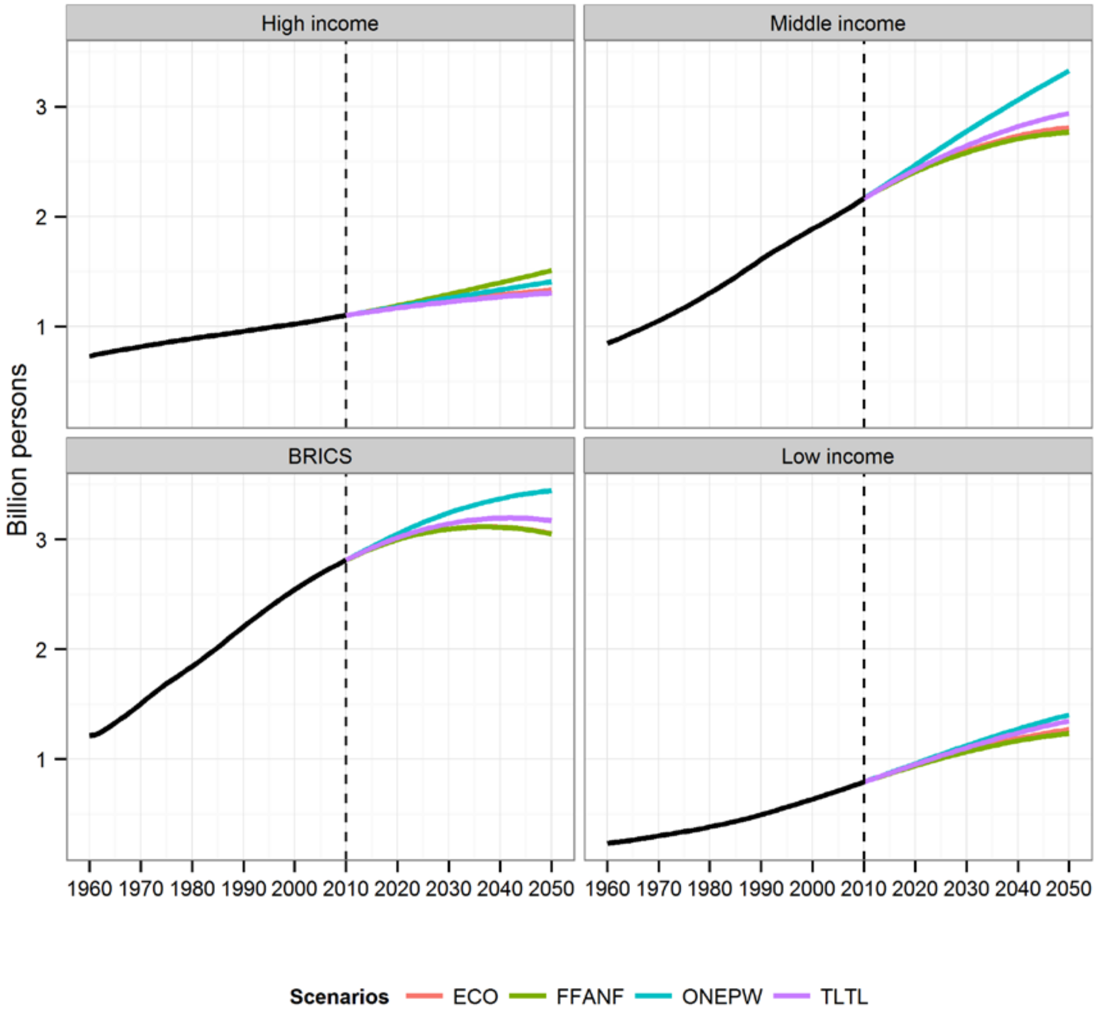
In the *Too little, too late* scenario, several new financial crises have resulted in a sharp decrease in economic growth. This situation has sparked national political crises, which in turn have given room for opportunistic behavior. Governance at the international level has also worsened: in 2050, there is no international cooperation and the whole UN system has dissolved. All of this has led to an unequal society, which consists of the "haves" and the "have nots", with the gap between the two groups widening over time. A select elite group ("the haves") holds the power and protects own interests, while the majority of people (the "have nots") is poor with limited access to food, health and education. There is monopolized access to knowledge and technology: the rich have access to modern technologies, while the poor do not. At the same time, the destructive effects of climate change, caused by uncontrolled depletion of (fossil) natural resources, caused biodiversity loss, an increase in natural disasters, and disputes about water. Regarding food and nutrition security, only the small minority of the "haves" benefits from food produced in a very unsustainable way, while the majority suffers from food and nutrition insecurity.

4.3 Key drivers

4.3.1 Population growth

Population growth is an important driver of global food demand and, therefore, of food security. The UN medium projection for global population expects total population to peak at 9 billion in 2050 and to slowdown thereafter (UNDESA, 2012). However, a very recent re-assessment of the data- for the first time including probabilistic projections - points out that the world population can be expected to increase from the current 7.2 billion people to 9.6 billion in 2050 and eventually reaching 10.9 billion in 2100 (Gerland et al., 2014). The main reason for the continued global population growth is an increase in the projected population of Africa. These findings demonstrate that future population growth is still very uncertain and confirms the need to use scenario analysis to assess the impact of population growth on global food security. Figure 4 depicts the population projections for the four country groups by scenario. Apart from the high income group, population growth is expected to be the highest in the *1% World* scenario. *Too little, too late* projections are in the middle for all country groups, while the results for *Food for all but not for everyone* and *Ecotopia* are at the bottom of the scale (except for high income group, where population growth is the highest). An important assumption in the *1% World* scenario is that population growth in the high income, medium income and BRICS countries is relatively high. The explanation for this pattern is that higher incomes make it possible to sustain larger families and households. In the *Food for all but not forever* scenario, migration plays a prominent role. It is assumed that people have possibility and are willing to migrate from poor to rich countries. The result of migration is high population growth in high income countries and low population growth in the other country groups. The *Too little, too late* scenario assumes that population growth in the high income countries, BRICS and middle income countries is slowing down, while expansion continues in the Low income countries. Finally, in the *Ecotopia* scenario, the storyline indicates that poverty is decreasing in developing countries and education and health systems are improving, leading to a stagnation in population growth.

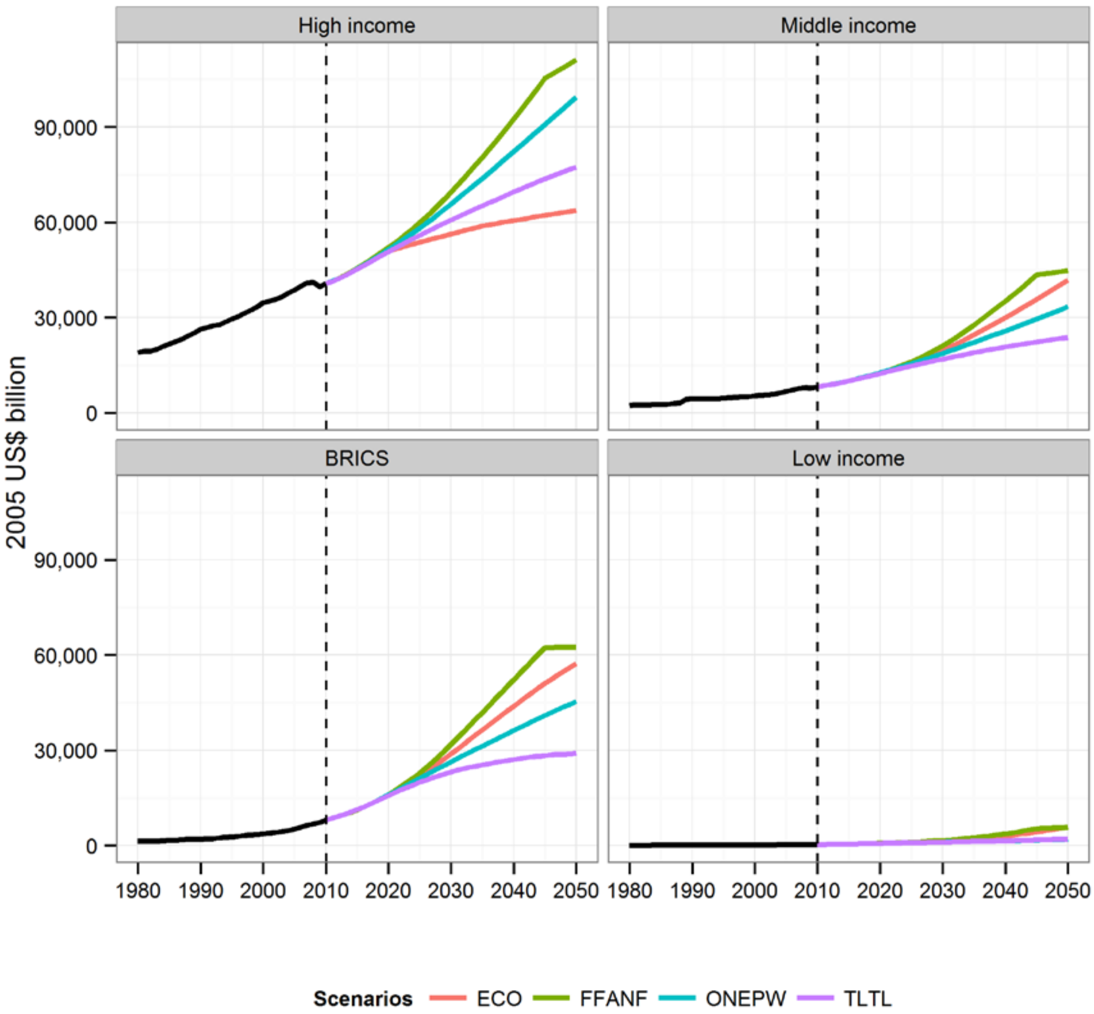
Figure 4: Population by scenario and income group: 1980-2050



4.3.2 GDP and income growth

GDP and GDP per capita growth are core measures of economic growth and development and, hence, strong drivers of food demand and supply (Cirera and Masset, 2010; Kearney, 2010). Comparing scenarios, GDP per capita growth is highest in the *Food for all but not forever* scenario and lowest in the *Too little, too late* scenario (except for the high income group), while the *Ecotopia* and *1% world* are in the middle range (Figure 5). The *Food for all but not forever* scenario sketches a world with rapid growth and growing equality, but at the same time with an implosion of the global economy in 2045, which has a clear impact on the future developments in the scenario. In contrast, the *Too little, too late* scenario foresees a fragmented world that is characterised by global income divergence and relatively low levels of development. The *1% world* ONEWP projects increasing inequality, but with relatively high growth in all regions, particularly in the high income countries. The high growth in the high income countries occurs due to innovations that are mainly adopted in the regions where the elite resides. GDP per capita growth in other regions is expected to be lower, because of the rise in global inequality. The main theme of the *Ecotopia* scenario is a sustainable and more equitable world with income per capita levels that converge.

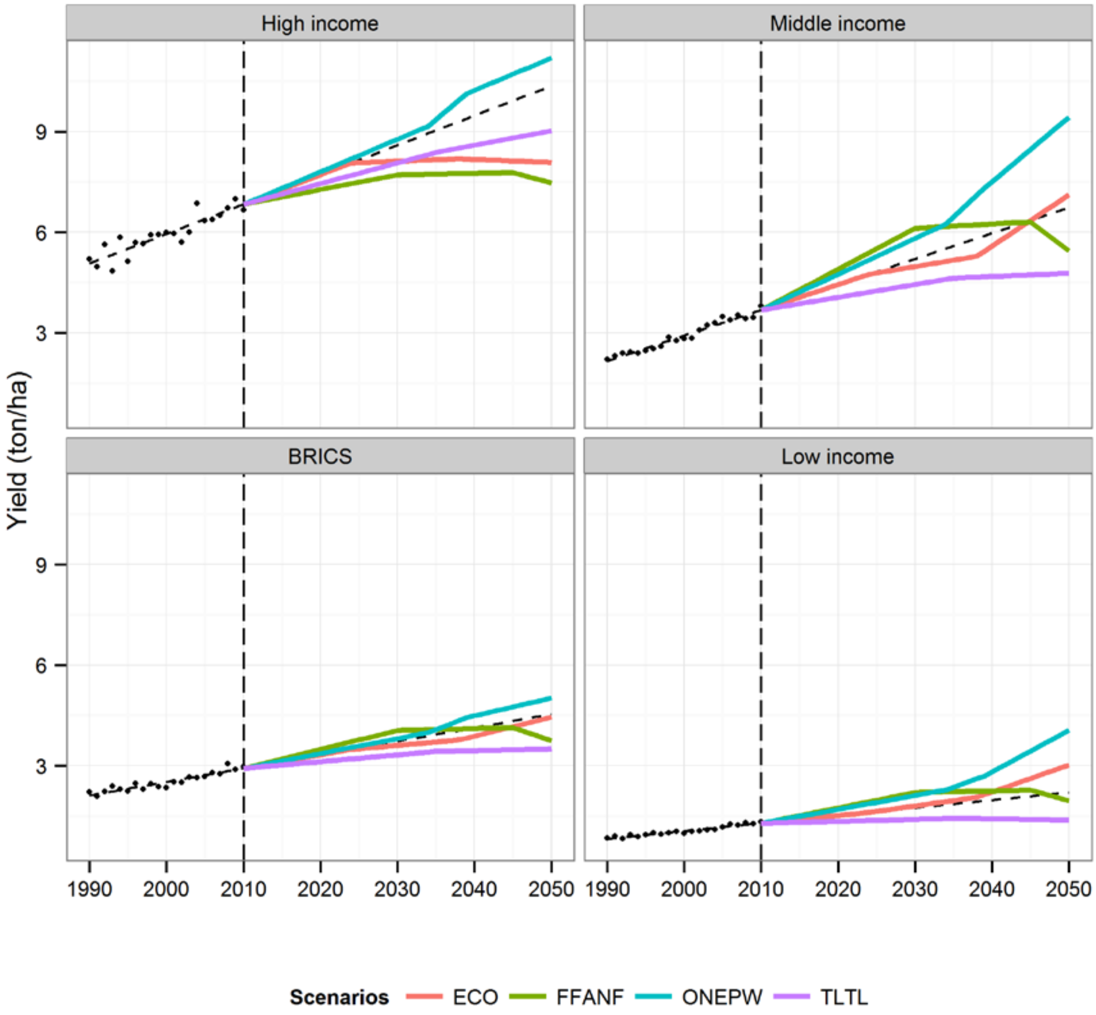
Figure 5: GDP by scenario and income group: 1980-2050



4.3.3 Crop yield

It has frequently been argued that yield gaps need to be closed to produce sufficient food for the global population in 2050 (Licker et al., 2010; Foley et al., 2011; Mueller et al., 2012) and that present rates of crop yield growth are not sufficient to achieve this (Ray et al., 2013). Assumptions on yield growth are therefore an important element of any scenario study that aims to assess future global food security. Figure 6 shows both the historical yield trend and the yield projections for each of the four scenarios by country income group. The figure presents the results for maize and other grains, but similar information is available for seven other crop groups.

Figure 6: Maize and other grains yield by scenario and income groups: 1990-2050



The yield projections are quite diverse across scenarios. An important part of the storyline in the *1% World* is rapid technological advancement (e.g. the new breeds and cultivation techniques) that occurs at specific points in time (around mid-2030) resulting in breakpoints in the crop yield projections. Innovations emerge in high income countries, but diffuse with a lag to other regions. The *Too little, too late* scenario assumes crop yield is going down in low-income regions due to the impact of environmental catastrophes, resulting from climate change. The middle-income countries reach a sort of plateau, while the yield in high-income countries increases, but at a slower rate, because of more resilient agricultural systems. In the *Food for all but not forever* scenario, yield is increasing rapidly in all regions due to the international diffusion of knowledge and more intensive production approaches. However, after around 2030, yield growth reaches a plateau and eventually collapses, due to the negative impact of climate change around 2045. The *Ecotopia scenario* foresees the existence of open source technologies that rapidly diffuse internationally. As a consequence, the low-income countries will close a large part of the yield gap by 2050. The crop yield in high-income countries will slightly decrease or stagnate, since yields would have reached the biophysical maximum potential by 2050.

5 Discussion

5.1.1 Scenario development process

The actually implemented scenario development process diverted from the original planning in two ways. First, following Kok et al. (2011), the initial idea was to use an existing set of scenarios (so-called 'fast-track' scenarios), as a basis for the FOODSECURE storylines to speed up the process and leave more room for the quantification of drivers. More specifically, it was foreseen to use the newly developed SSP scenarios as a starting point and ask stakeholders to add or refine food security related components. However, during the process, stakeholders raised the concern that the SSPs did not cover all plausible futures and are too strongly geared towards climate change, and are therefore not able to adequately take into account the relevant aspects of future food and nutrition security. To accommodate these concerns, we decided go through a full scenario development process of defining key uncertainties and develop the scenario logic from the bottom up. The lesson that can be drawn from this is that stakeholders are likely to be unwilling to accept scenarios that have been created for a different subject and purpose. Therefore researchers and scenario developers should be careful in using existing storylines as basis for scenario development.

Second, it was planned to use the SAS approach (Alcamo, 2008a) to introduce a feedback loop between the storylines developed by stakeholders and quantitative model results that are based on them. Unfortunately, because of the aforementioned change in the scenario planning process, the storylines were not completed after the first workshop, which made it impossible to use them as input for the model simulations. Given the available resources, it was not possible to organize additional workshops and the iteration between stakeholder-determined storylines and expert-driven model runs had to be omitted. The consistency check between storylines and model results has been done by researchers only, which is a clear shortcoming in the participatory scenario building process.

5.1.2 Stakeholder evaluation

To guarantee relevance, credibility, legitimacy and creativity of the FOODSECURE scenarios, stakeholder participation has been central part of scenario development process. It is therefore important to evaluate stakeholder satisfaction and find out whether the participants support the scenario outcomes. The results from the questionnaire that was handed out after each workshop pointed out that the majority of participants were generally very satisfied with the facilitation, the content support and the practical arrangements. A few comments indicated that the overall process was less clear in the first workshop, but it was nevertheless rated good or very good by 89,5% of the participants. The fact that the workshop process was adjusted during the workshop to accommodate the stakeholders' need for more discussion on new scenarios (as compared to the SSPs), had a very positive impact on stakeholder satisfaction, reflected in the 94,5% satisfaction rate (very good and good) with regards to the facilitation. A large majority (93%) agreed that the scenario-building process as a whole was useful in developing strategies for food and nutrition security.

5.1.3 Quantification of drivers

A novel approach – participatory trend mapping – was used to obtain projections for a number of important long-run drivers of food security. We found that this approach was very useful in discussing and assessing a relative large number of driving forces with stakeholders in a relatively short time. The use of pictures with historical trends proved a simple, intuitive and effective way of quickly informing stakeholders about indicators they were previously not familiar with and helped to generate realistic future trends. A positive side effect was that in several instances the mapping of drivers led to a renewed discussion about the internal consistency of the scenarios and consequential adjustment. A disadvantage of participatory trend mapping, in contrast with fuzzy set theory that directly provides numerical values, is that researchers still have to post-process to translate the trends into numbers. This might introduce a bias and highlights the need for the validation of results in which stakeholders have to opportunity to provide comments and after which projections can still be revised. Nonetheless, we are of the opinion that participatory trend mapping is interesting and new new tool that can also be used in other scenario building exercises.

5.1.4 Comparison with drivers in other scenarios and projections

The future of global food and nutrition security has been partly assessed within global assessment projects with larger focus (see Dijk van and Meijerink, 2014 for a review). Figure 7 compares the trends in population, GDP and yield with that of previous scenarios studies. It reveals that the GDP projections are distributed evenly across the plausible range, while populations trajectories cover a smaller bandwidth. This can be partly explained by the fact that older assessments (e.g., the IPCC SRES scenarios) tend to have higher population projections than more recent assessments. The yield projections describe a wide range of possible pathways, even approaching the outermost projection in the sample of reviewed scenarios.

Recently, Van Vuuren et al. (2012) proposed a typology of six 'archetypical' scenarios that share perspectives on key uncertainties regarding future developments and, as a result, also have similar assumptions for different driving forces. The six identified archetypes include: Economic Optimism scenarios, Reformed Market scenarios, Global Sustainable Development scenarios, Regional Competition scenarios, Regional Sustainable Development scenarios, and Business-as-usual scenarios. The FOODSECURE scenarios – together with other global scenario-based assessments – can be mapped against the defined "archetypes" (Table 2). Apart from the 1% World, it is relatively straightforward to classify the FOODSECURE scenarios. We decided to allocate 1% World to the reformed markets type because it also features rapid economic development and technological change as well as environmental protection. However, the fit is not perfect as inequality, a key element of the 1% World, is not captured and also the population trend is different.

Overall, the comparison shows that the FOODSECURE scenarios capture a wide range of possible future pathways, which are in range with the other global integrated scenario-based assessments without being too extreme.

Table 2: Recent scenario-based assessments mapped against scenario 'archetypes'

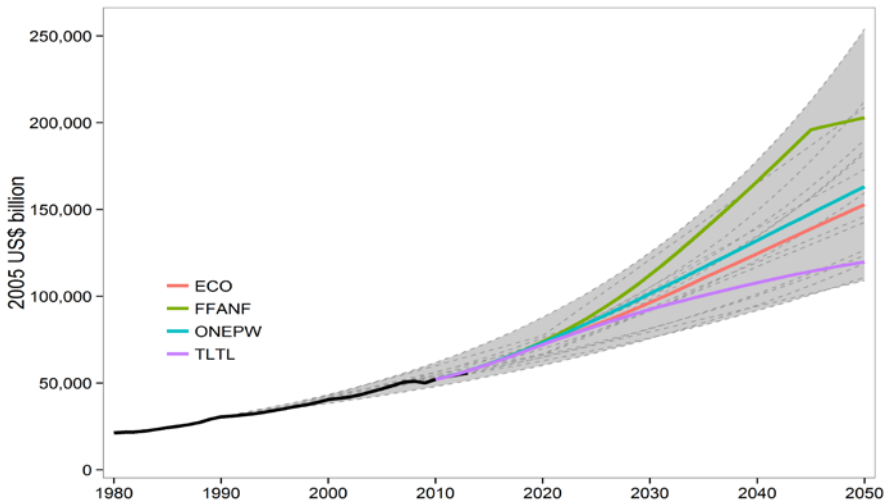
	Scenario-based assessments			
Scenario archetypes	IPCC-SRES	MA	UNEP GEO-3	FOODSECURE
Conventional Markets	A1/A1T/A1B		Market first	Food For All but not forever
Reformed Markets		*Global orchestration*	Policies first	*1% World*
Global SD	B1 (B1-450)	Techno garden	Sustainability first	
Regional Competition	A2	Order from strength	Security first	Too little, too late
Regional Sustainable Development	B2	*Adapting mosaic*		Ecotopia
Business-as-usual	B2			

Note: Italics are used to indicate that scenarios are not completely consistent with the group in which it is categorised.

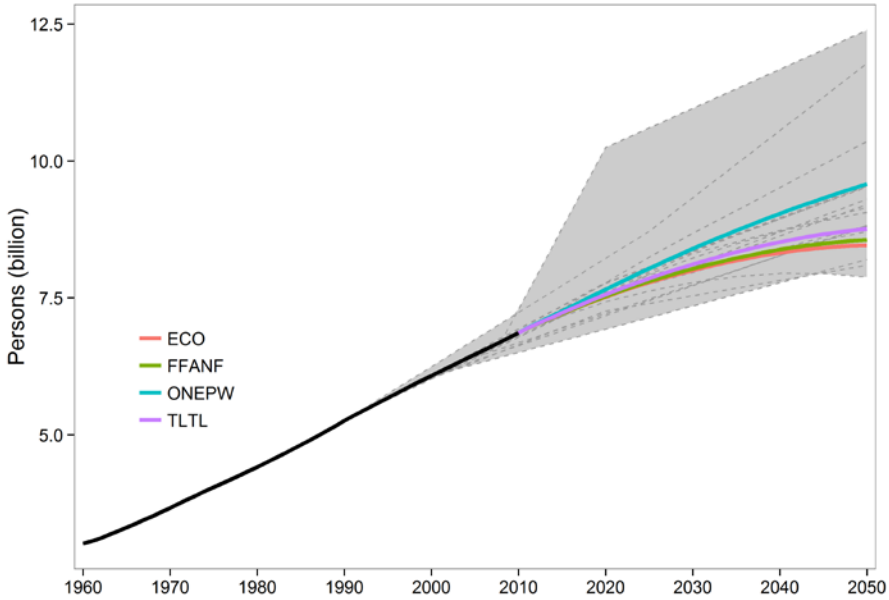
Source: Van Vuuren et al. (2012) and authors.

Figure 7a, b, c: Comparison with scenario drivers

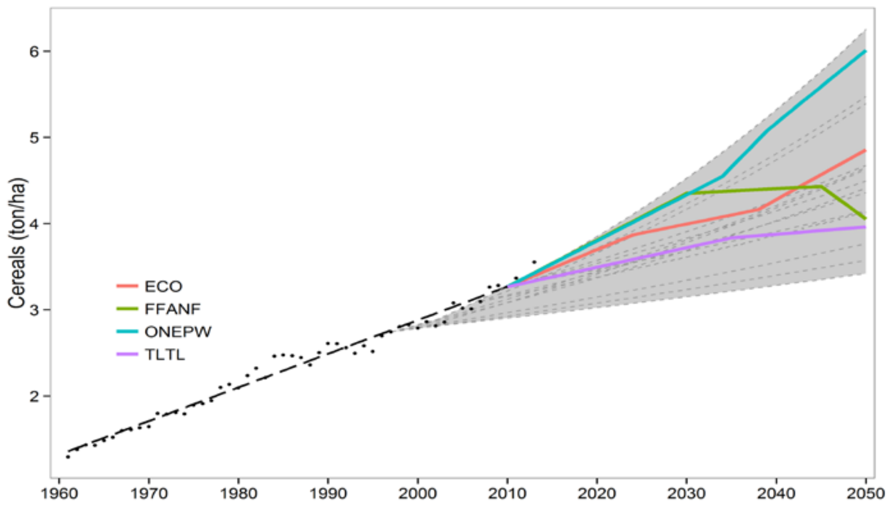
(a) GDP



(b) Population



(c) Yield



6 Conclusions

This paper describes the development process and results from a participatory scenario exercise to develop a set of global scenarios to be used in conjunction with global impact assessment models to investigate the dynamics in long-run global food security. The outcomes of the process are four different scenarios that cover a large spectrum of possible futures, defined along two axes: (in)equality, and lifestyle and natural resources. A number of conclusions can be drawn from our experience in building FOODSECURE scenarios. First, a participatory approach towards scenario development, involving a diverse group of stakeholders, combined with a professional management and planning of the process, leads to creation of innovative and diverse scenarios. It is unlikely that the derived scenarios would also have resulted from an exercise that mainly involved scientists. Second, a fast-track approach towards scenario building is not without difficulties and risk. In this study, stakeholders were not convinced by the selected fast-track scenarios. The process was successfully adapted, yet the adaptation led to a substantial delay. Finally, participatory trend mapping, a novel approach first tested in this paper, in combination with thorough validation, proved to be a useful tool to derive realistic trends of long-term driving forces of global food and nutrition security.

References

Abramovitz, M., 1986. Catching Up, Forging Ahead, and Falling Behind. J. Econ. Hist. 46, 385–406. doi:10.1017/S0022050700046209

Alcamo, J., 2008a. The SAS approach: Combining qualitative and quantitative knowledge in environmental scenarios, in: Alcamo, J. (Ed.), Environmental Futures: The Practice of Environmental Scenario Analysis. Elsevier, Amsterdam.

Alcamo, J., 2008b. Environmental futures: the practice of environmental scenario analysis. Developments in Integrated Environmental Assessment - volume 2. Elsevier, Amsterdam.

Alcamo, J., Henrichs, T., 2008. Towards guidelines for environmental scenario analysis, in: Alcamo, J. (Ed.), Environmental Futures: The Practice of Environmental Scenario Analysis. Elsevier, Amsterdam, pp. 13–35.

Alexandratos, N., Bruinsma, J., 2012. World agriculture towards 2030/2050: the 2012 revision. ESA Working paper Rome, FAO.

Alexandratos, N., Bruinsma, J., Bödeker, G., Schmidhuber, J., Broca, S., Shetty, P., Ottaviani, M.G., 2006. World agriculture: Towards 2030/2050. Interim report. FAO, Rome, Italy.

Berkhout, F., Hertin, J., Jordan, A., 2002. Socio-economic futures in climate change impact assessment: using scenarios as “learning machines.” Glob. Environ. Change 12, 83–95. doi:10.1016/S0959-3780(02)00006-7

Börjeson, L., Höjer, M., Dreborg, K.-H., Ekvall, T., Finnveden, G., 2006. Scenario types and techniques: Towards a user’s guide. Futures 38, 723–739. doi:10.1016/j.futures.2005.12.002

Bouwman, A.F., Van der Hoek, K.W., Eickhout, B., Soenario, I., 2005. Exploring changes in world ruminant production systems. Agric. Syst. 84, 121–153. doi:10.1016/j.agsy.2004.05.006

Carpenter, S.R., Pingali, P.L., Bennett, E.M., Zurek, M. (Eds.), 2005. Ecosystems and human well-being: Scenarios, Volume 2. Island Press, Washington, DC.

Chaudhury, M., Vervoort, J., Kristjanson, P., Ericksen, P., Ainslie, A., 2012. Participatory scenarios as a tool to link science and policy on food security under climate change in East Africa. Reg. Environ. Change 13, 389–398. doi:10.1007/s10113-012-0350-1

Cirera, X., Masset, E., 2010. Income distribution trends and future food demand. Philos. Trans. R. Soc. B Biol. Sci. 365, 2821–2834.

Dijk van, M., Meijerink, G.W., 2014. A review of global food security scenario and assessment studies: Results, gaps and research priorities. Glob. Food Secur., SI: GFS Conference 2013 3, 227–238. doi:10.1016/j.gfs.2014.09.004

Dorin, B., Paillard, S., 2009. Agrimonde: Scenarios and challenges for feeding the world in 2050. Summary report. INRA & CIRAD.

Fagerberg, J., Verspagen, B., 2002. Technology-gaps, innovation-diffusion and transformation: an evolutionary interpretation. Res. Policy 31, 1291–1304. doi:10.1016/S0048-7333(02)00064-1

Fischer, R.A., Edmeades, G.O., 2010. Breeding and Cereal Yield Progress. Crop Sci. 50, S–85–S–98. doi:10.2135/cropsci2009.10.0564

Foley, J.A., Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., Mueller, N.D., O/'Connell, C., Ray, D.K., West, P.C., Balzer, C., Bennett, E.M., Carpenter, S.R., Hill, J., Monfreda, C., Polasky, S., Rockstrom, J., Sheehan, J., Siebert, S., Tilman, D., Zaks, D.P.M., 2011. Solutions for a cultivated planet. Nature 478, 337–342. doi:10.1038/nature10452

Gerland, P., Raftery, A.E., Ševčíková, H., Li, N., Gu, D., Spoorenberg, T., Alkema, L., Fosdick, B.K., Chunn, J., Lalic, N., Bay, G., Buettner, T., Heilig, G.K., Wilmoth, J., 2014. World population stabilization unlikely this century. Science 346, 234–237. doi:10.1126/science.1257469

Gramberger, M., Zellmer, K., Kok, K., Metzger, M.J., 2014. Stakeholder integrated research (STIR): a new approach tested in climate change adaptation research. Clim. Change 1–14. doi:10.1007/s10584-014-1225-x

Grassini, P., Eskridge, K.M., Cassman, K.G., 2013. Distinguishing between yield advances and yield plateaus in historical crop production trends. Nat. Commun. 4. doi:10.1038/ncomms3918

Hafner, S., 2003. Trends in maize, rice, and wheat yields for 188 nations over the past 40 years: a prevalence of linear growth. Agric. Ecosyst. Environ. 97, 275–283. doi:10.1016/S0167-8809(03)00019-7

INRA/DLO, 2012. Deliverable 2.1: Storylines for the livestock sector scenarios in EU, studied SICA regions and global level, Animal Change FP7.

Kearney, J., 2010. Food consumption trends and drivers. Philos. Trans. R. Soc. Lond. B Biol. Sci. 365, 2793–2807. doi:10.1098/rstb.2010.0149

Kok, K., Bärlund, I., Flörke, M., Holman, I., Gramberger, M., Sendzimir, J., Stuch, B., Zellmer, K., 2014. European participatory scenario development: strengthening the link between stories and models. Clim. Change 1–14. doi:10.1007/s10584-014-1143-y

Kok, K., van Vliet, M., Bärlund, I., Dubel, A., Sendzimir, J., 2011. Combining participative backcasting and exploratory scenario development: Experiences from the SCENES project. Technol. Forecast. Soc. Change 78, 835–851. doi:10.1016/j.techfore.2011.01.004

Kriegler, E., O'Neill, B.C., Hallegatte, S., Kram, T., Lempert, R.J., Moss, R.H., Wilbanks, T., 2012. The need for and use of socio-economic scenarios for climate change analysis: A new approach based on shared socio-economic pathways. Glob. Environ. Change 22, 807–822. doi:10.1016/j.gloenvcha.2012.05.005

Laborde, D., Tokgoz, S., Torero, M., 2013. Long-term drivers of food and nutrition security (FOODSECURE Working Paper No. 6).

Licker, R., Johnston, M., Foley, J.A., Barford, C., Kucharik, C.J., Monfreda, C., Ramankutty, N., 2010. Mind the gap: how do climate and agricultural management explain the "yield gap" of croplands around the world? Glob. Ecol. Biogeogr. 19, 769–782. doi:10.1111/j.1466-8238.2010.00563.x

Maddison, A., 2001. The World Economy. Organisation for Economic Co-operation and Development, Paris.

Mueller, N.D., Gerber, J.S., Johnston, M., Ray, D.K., Ramankutty, N., Foley, J.A., 2012. Closing yield gaps through nutrient and water management. Nature 490, 254–257. doi:10.1038/nature11420

O'Neill, B., Carter, T.R., Ebi, K., Edmonds, J., Hallegate, S., Kemp-Benedict, E., Kriegler, E., Mearns, L., Moss, R., Riahi, K., van Ruijven, B., van Vuuren, D., 2012. Meeting report of the workshop on the nature and use of socioeconomic pathways for climate change research. Boulder, CO.

Ray, D.K., Mueller, N.D., West, P.C., Foley, J.A., 2013. Yield Trends Are Insufficient to Double Global Crop Production by 2050. PLoS ONE 8, e66428. doi:10.1371/journal.pone.0066428

Reilly, M., Willenbockel, D., 2010. Managing Uncertainty: A Review of Food System Scenario Analysis and Modelling. Philos. Trans. R. Soc. B Biol. Sci. 365, 3049–3063. doi:10.1098/rstb.2010.0141

Rittel, H.W.J., Webber, M.M., 1973. Dilemmas in a general theory of planning. Policy Sci. 4, 155–169. doi:10.1007/BF01405730

Tilman, D., Balzer, C., Hill, J., Befort, B.L., 2011. Global Food Demand and the Sustainable Intensification of Agriculture. Proc. Natl. Acad. Sci. 108, 20260–20264. doi:10.1073/pnas.1116437108

UNDESA, 2012. World Population Prospects: The 2010 Revision and World Urbanization Prospects: The 2011 Revision [WWW Document]. URL http://esa.un.org/unpd/wup/index.htm (accessed 7.14.12).

van Notten, P.W.., Rotmans, J., van Asselt, M.B.., Rothman, D.S., 2003. An updated scenario typology. Futures 35, 423–443. doi:10.1016/S0016-3287(02)00090-3

van Vliet, M., Kok, K., Veldkamp, T., 2010. Linking stakeholders and modellers in scenario studies: The use of Fuzzy Cognitive Maps as a communication and learning tool. Futures 42, 1–14. doi:10.1016/j.futures.2009.08.005

van Vuuren, D.P., Kok, M.T.J., Girod, B., Lucas, P.L., de Vries, B., 2012. Scenarios in Global Environmental Assessments: Key characteristics and lessons for future use. Glob. Environ. Change 22, 884–895. doi:10.1016/j.gloenvcha.2012.06.001

Vervoort, J.M., Thornton, P.K., Kristjanson, P., Förch, W., Ericksen, P.J., Kok, K., Ingram, J.S.I., Herrero, M., Palazzo, A., Helfgott, A.E.S., Wilkinson, A., Havlík, P., Mason-D’Croz, D., Jost, C., 2014. Challenges to scenario-guided adaptive action on food security under climate change. Glob. Environ. Change 28, 383–394. doi:10.1016/j.gloenvcha.2014.03.001

Westhoek, H.J., van den Berg, M., Bakkes, J.A., 2006. Scenario development to explore the future of Europe’s rural areas. Agric. Ecosyst. Environ. 114, 7–20. doi:10.1016/j.agee.2005.11.005

Wilkinson, A., Eidinow, E., 2008. Evolving practices in environmental scenarios: a new scenario typology. Environ. Res. Lett. 3, 045017. doi:10.1088/1748-9326/3/4/045017

Wirsenius, S., Azar, C., Berndes, G., 2010. How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? Agric. Syst. 103, 621–638. doi:10.1016/j.agsy.2010.07.005

WRI, 2013. Creating a sustainable food future. A menu of solutions to sustainably feed more than 9 billion people by 2050, World Resources Report 2013-14: Interim Findings. World Resources Institute (WRI), Washington DC, USA.

The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)
Short description	In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed. The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security. FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security. FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.
EU Contribution	€ 8 million
Research team	19 partners from 13 countries

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