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African Agricultural Futures

Opportunities, Challenges and Priorities

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Abstract:

In this paper, we describe some key future drivers for Africa's agricultural landscape, and highlight their implications for future productivity, agricultural rural income generation potential and food security. This work is built on an examination of recent futures-oriented work that applies methods of foresight and projections to better understand the driving forces that will shape the future of Africa's agriculture. Although there is a good body of work that has been done to look at the global level to examine the future interactions between the environment, agriculture and other important ecosystems – the information on Africa, from these studies, has not been sufficiently detailed to represent the heterogeneity of the agricultural landscape and markets across Africa. We point to better examples of foresight for Africa that can provide insight as to how the constraints and opportunities for agricultural growth seen in various sub-regions of the continent can be dealt with effectively by interventions of policy and technology. We also underscore some critical drivers of change that will be instrumental in shaping the trajectory of African agricultural growth in the decades to come.

1. Introduction

Persistent concerns surrounding the future of agriculture and food security have fueled the ongoing discourse over which actions and interventions are needed to reverse worrying trends of malnutrition, and strengthen the performance of the agricultural sector – especially in developing nations. Accompanying the world's steady population and income growth, is an increasing demand for food and the necessary feedstuffs to enable the requisite growth in the production of input- and energy-intensive products such as livestock, fiber and even fuel products (MA 2005; IAASTD 2009; Alexandratos 2011, Msangi and Rosegrant, 2011a). The combination of these trends will inevitably lead to greater stresses and demands on the natural resource base and eco-systems that underlie the world's food production systems (GO-Science, 2011). The challenge of how to 'feed the world to 2050' has been raised by FAO in its high-level consultations that followed upon the food price crises of 2007 and 2009, and touches upon a range of issues that span from improving field-level agricultural performance to strengthening the governance of the global food economy through improved coordination of information and policy interventions by key institutions (Conforti and Sarris, 2011).

The challenges on food production systems that result from the concurrence of steady socio-economic change with increasing environmental variability are particularly relevant for Sub-Saharan Africa, where persistent levels of food insecurity already exist. To illustrate, from the 1990-92 period to the 2010-2012 period, the share of the world's undernourished in Sub-Saharan Africa has increased from 17 to 27% (FAO-WFP-IFAD, 2012) and the prevalence of undernourishment remains at nearly the same 23% level that it was in the 2007-09 period – representing 239 million people. According to the latest Global Hunger Index report (von Grebmer *et al*, 2012), most of the countries with 'alarming' Global Hunger Index values are in Sub-Saharan Africa and South Asia. Some important constraints that undermine the pace of improvement, in the face of these challenges, is the fact that most of Sub-Saharan Africa's agricultural production relies on rainfed cultivation, and receives lower input levels of improved seed technology and fertilizer applications than other regions. Additionally, the area affected by land degradation within the region is expanding and is thereby causing a decline in soil fertility that reduces yield levels and increases the difficulty in maintaining sufficient production levels, especially when considering the lack of technological innovation and fertilizer use (UN-FAO, 2005). Improved seed varieties and fertilizer use were key inputs that contributed to the Asian Green Revolution, which brought Asia from a situation of food-deficit to food exportation (Durjfeldt *et al*., 2005). This suggests that Sub-Saharan Africa may be lacking important scientific inputs that may be the only source of hope for increasing yields in the face of climatic uncertainty and poor soil quality.

Key development goals for Sub-Saharan Africa – as are embodied in the Comprehensive Africa Agricultural Development Program (CAADP) – depend upon the ability of agriculture to raise incomes and improve rural livelihoods, so that people can be lifted out of poverty and hunger at a faster rate. Diao et al (2012) have pointed to the economy-wide growth dynamics that are necessary to meet these goals, and argue for the importance of linkages between the non-agricultural sector and rural income generation. Others have addressed the considerable investments that need to be made in agriculture, in order for its performance to match the levels anticipated in the CAADP goals (Nin-Pratt *et al*, 2011). These studies, along with many other types of forward-looking assessments for Africa, try to anticipate the actions that need to be taken now – either in the form of policy- or technology-related interventions and investments, in order to positively affect human well-being outcomes in the future. Future-oriented studies also try to recognize the important 'tipping points' that could be critical determinants of how future trends evolve, and to explore which of the key uncertainties about the future could be real 'game-changers' for market dynamics and human welfare outcomes. Doing so helps to identify useful entry points where (well-timed) interventions could be critical in keeping economic growth and human development on-track.

Not enough of these forward-looking assessments have been done for Africa, however, in a way that is detailed and nuanced enough to capture the complexity and heterogeneity of Africa's agricultural landscape. As policymakers in Africa continue to become increasingly aware of the future challenges posed by regional and global socio-economic and environmental change, they will require guidance that is appropriate for their regions, and will need to design innovative strategies that will allow their particular crop production and food systems to adapt to these changing conditions. Comprehensive and detailed assessments of Africa's agricultural future can help to bring those regions and sectors which are under-performance to the attention of analysts and policy makers, and enable them to better devise the appropriate interventions and development strategies that are suited for them.

In the rest of this paper, we discuss the importance of applying forward-looking assessments to African agriculture, and the important insights and lessons that can come from doing so. By pointing out the relatively small number of researchers that are engaged in this effort – compared to foresight efforts for other regions of the world – we also make an argument for undertaking more detailed assessments of Africa's future agricultural potential and challenges, so as to improve the base of knowledge that exists and bring some much-needed refinements to the way in which Africa's agricultural future is viewed by the wider research community.

1.1 Why do future studies for agriculture?

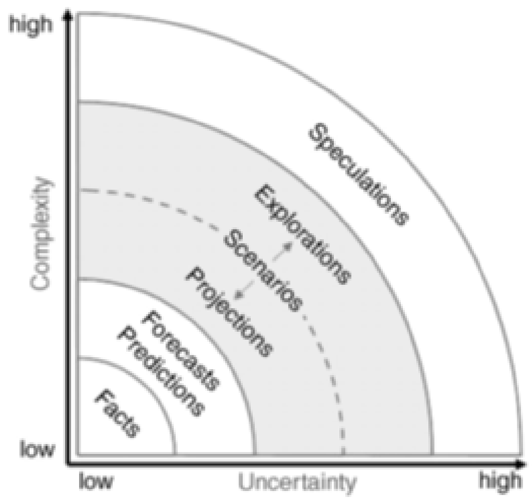
Forward-looking assessments are a common tool used in the business community to challenge present assumptions about where future commercial potential may lie, and to explore the implications of a few key areas of uncertainty that have the potential to be real 'game-changers' in the business. The agricultural sector, like other sectors of the economy, also faces a number of key uncertainties concerning the sources of future production and demand growth, as well as the impact of external forces that might come either from government policy or from the environment. Therefore, the need for foresight and forward-looking studies focused on agriculture is strong – especially where it concerns the well-being of billions of poor households around the world who depend on the agricultural sector for their livelihood.

Foresight exercises are built around the development and analysis of plausible pathways over which events may unfold, and which are embodied in alternative cases that may be taken into consideration – i.e. scenarios. The building of scenarios provides a means whereby potential future occurrences and the uncertainties that surround them can be assessed in a structured, yet creative manner (Zurek and Henrichs 2007). Scenarios create narratives about future occurrences and how these may unfold according to "if-then" propositions, and they can be constructed upon the basis of either qualitative or quantitative information or a combination of both. Their use often involves the creation of multiple alternatives which are later compared with each other as a means of determining the most accurate and useful predictor among several (Raskin 2005).

Scenario-based foresight exercises are especially appropriate when assessing the high levels of uncertainty that accompany future movement in complex systems. Depending on the timeline of the assessment, foresight exercises involving scenarios may require a reduction in the complexity of a system which can be achieved by an examination of only a part of the system or a focus on a single question within a scenario (Zurek and Henrichs 2007). Therefore, foresight exercises involving projections around food security and agriculture – while impossible to conduct without some exploration and recognition of the contributing factors and the complex global system within which they exist – can, nonetheless, be simplified by bringing together the most pertinent elements that define it. These elements will usually include a set of main questions, systemic driving forces, the basic overarching logic and decision making paradigms used in each scenario and a break-down of future outcomes that may interest stakeholders.

Scenario-based foresight exercises should however be clearly differentiated from other types of naive foresight – which can range from forecasts, predictions, projections and all the way to pure speculation. The figure below (Figure 1) illustrates the differences between these, in terms of the degree to which there is uncertainty about the nature of future drivers and outcomes, and the degree of complexity that is embodied in the processes of change.

Figure 1: The difference between fact, forecasts, predictions and speculations



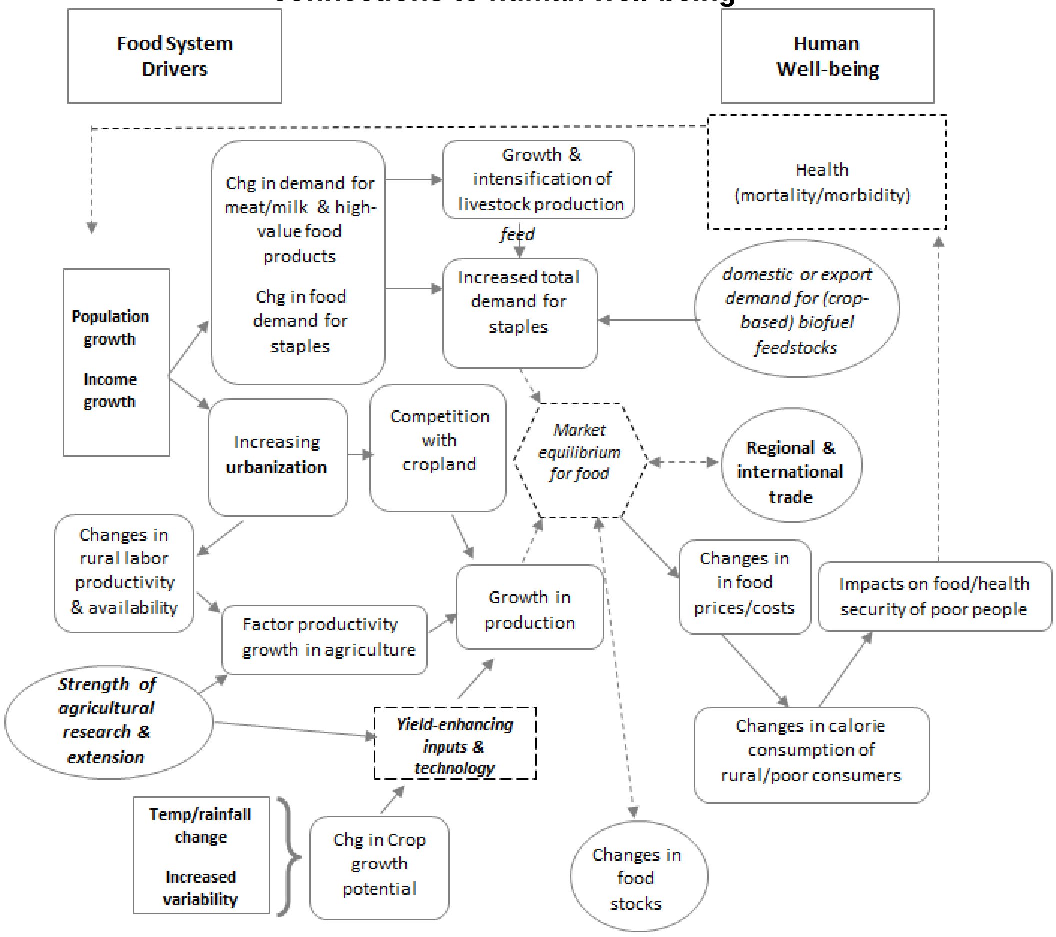
(source: Zurek and Henrichs 2007)

Unlike these cases, scenario-based foresight exercises do not assume that the world, regardless of the passage of time, remains in its present boundary conditions. On the contrary, it is oftentimes clearly based on the assumption that these boundary conditions will be subject to substantial change in the future. Therefore, they allow decision-makers to think through the implications of actions they decide to take in the present while remaining cognizant of the fact that decision-making conditions as they exist today could potentially be vastly different in the future. This helps to drive considerations of changing processes and causal chains that impact the future (Rotmans et al. 2000).

Critical drivers of future change in agriculture

One of the key components to engaging in forward-looking assessments of agriculture is that of identifying what the critical drivers of change are that will influence the trajectory of production, consumption and market exchange. The schematic below illustrates some of the most important drivers that shape the future dynamics of agricultural and its connection to household welfare (Figure 2).

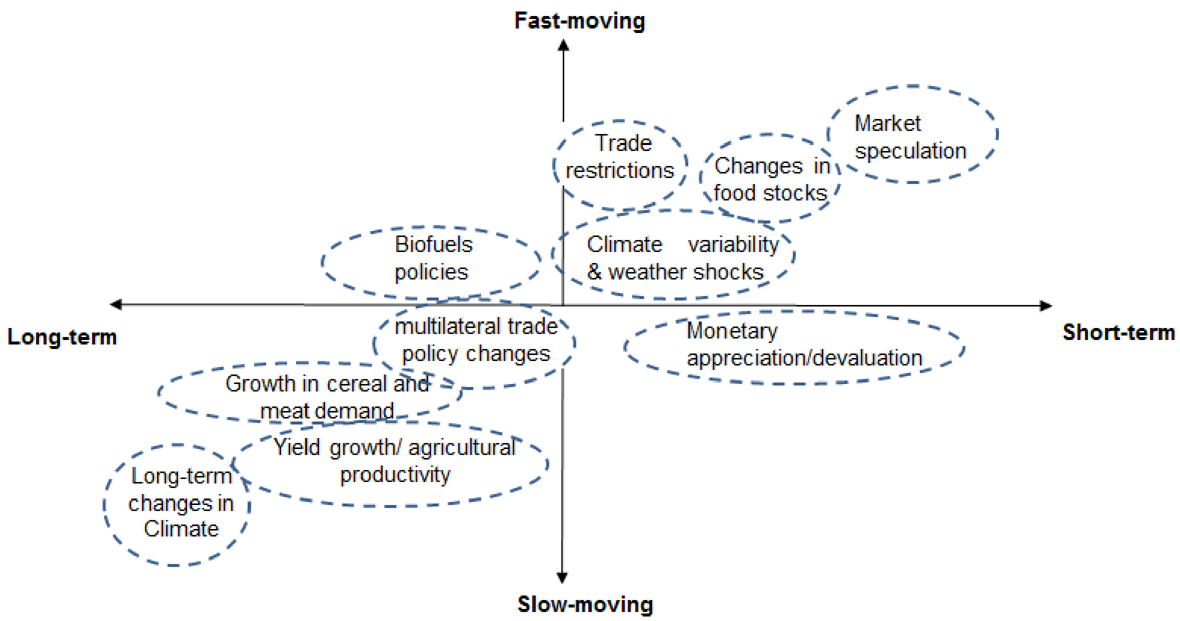
Figure 2. The interrelationships between key drivers of change in food systems and their connections to human well-being



The relative rate of change in the growth (or decrease) of the various drivers shown in the schematic, will determine the trajectory that agricultural supply, demand and trade/exchange will take in any particular region. There are some drivers which are purely of an environmental nature (e.g. climate outcomes of temperature and rainfall), whereas others are more policy-oriented, such as the production of biofuels (or its feedstocks), the management of food stocks, trade policy or the investments in the agricultural research and extension system. Many of these drivers have been cited as important determinants in past food price crises (Headey and Fan, 2010) and continue to be the focus of active policy research and debate about the future of agriculture.

Depending on which of these drivers one wants to address – the nature of the forward-looking assessment will change according to the time horizon under consideration. Some of these drivers are relatively short-lived and fast-acting, and might determine the market dynamics that evolve over the course of weeks or months – whereas others might be more long-lasting and slower-moving in their nature. In Figure 3, below, we see a number of fast- and slow-moving drivers of change depicted.

Figure 3. Characterizing drivers of change in agricultural systems



(Adapted from Msangi and Rosegrant, 2011b)

At one end of the spectrum (in the upper right corner), the fast-moving drivers act to determine short-term market outcomes – where one might observe fast 'blips' in prices that are created by speculative bubbles that might form from positions taken in agricultural futures markets or by traders holding stocks of grains. Trade bans might also act to exacerbate market situations that might be created when shortfalls (or even their threat) occur, and were important determinants of the trends seen in rice in the 2007-08 period (Headey and Fan, 2010).

At the other end of the spectrum, in the lower left corner, we find relatively slow-moving phenomena that play a part in determining the long-term evolution of agricultural market trends – such as long-term change in climatic conditions. Climate change, as a slow-moving phenomenon, should be distinguished from effects of climatic *variability* and extreme weather incidents that are already manifest in many regions and which are of a shorter-term nature. Other drivers such as diet change, might evolve more slowly, as the process of income growth and urbanization happens – but might still have a big impact on the type and quality of foods that are demanded in the medium- to long-term. The development of agribusiness sectors such as biofuels, might also influence the medium- to long-term trajectory of agricultural demand within a region, as the investments in production facilities are completed and the value chain accommodates the growth of this new sector.

Depending on which one of these drivers an analyst is interested in examining – the use of either a short-, medium- or long- term framework for analysis might be called for. If one wants to explore the implications of fast-moving events that are unfolding now, on the near-term future of agricultural markets – then a short-term forecast analysis which projects a year or two ahead, is likely to be the framework of choice. These types of analyses are geared towards a commercial audience that wishes to be informed of changes in market positions that might be relevant to their decisions on current market operations or to form some expectations of price that are useful for investment decisions. Within a fast-moving market environment, these kinds of informed (and mostly quantitative) outlooks can be a useful basis for decision-making.

In order to explore the implications of those drivers of change that are more slow-moving, there are more medium–term assessments which look up to 10 years ahead, and examine the longer-term market trends that are implied under an existing set of agricultural policies and a forseen trajectory of population and income change (which are held constant over the 'baseline' projection period). Under alternative scenarios, they can explore the market implications of changes to particular policies (such as that for biofuels or trade), which might plausibly unfold over the course of the 10-year period. By comparing the how the trajectories of supply, demand or trade might shift under such scenarios – in relation to the baseline case – they provide insight as to the importance of these changes, and what the magnitude (and distribution) of impacts might be across various markets. This type of forward-looking assessment provides useful information to both policy-makers and market analysts who want to understand what plausible set of trends are implied by current policies, and what the implications of individual policy changes are. On the commercial side, some firms interested in making longer-term investments might want to consider what the medium-term outlook for those products would be, in order to judge whether the prevailing trend might be favorable or not towards a particular investment decision. Even though long-term climate change effects might not be perceptible over a horizon as short as 10 years – the increased frequency of climate events could be explored with this type of medium-term assessment.

A longer-term assessment would be more pertinent to judging the effect of fairly slow-moving forces of change – such as that of climate change, or the payoffs to agricultural (or other science) research and development, which tend to have long periods of lag between when the investments are made, and when the benefits start to be realized. In the case of agricultural research and investment, the lag periods could be up to 30 or more years (Alston et al. 2010). Given the high degree of uncertainty that can exist about the shape those drivers will take along their pathway, the specification of scenarios is key. The scenarios for these assessments tend to be complex, and embody a 'storyline' that places the evolution of population, income, investment, policy, environment and other factors within the context of how national, regional and global policy is oriented – whether 'pro-growth' or 'pro-environment' (for example) – and speak to the way in which the future can evolve quite differently under alternative paradigms of governance and social progress. These type of comparisons between 'worlds' of agriculture help to illustrate how critical the political-economy can be in determining socio-economic outcomes, and whether or not certain long-term goals such as climate-change mitigation or trade-liberalization are realized. Without necessarily putting a probability of which alternative paradigm is likely to develop in future – examining these alternatives can also show how the same types of interventions might have very different outcomes or impacts depending on how the rest of the policy environment is oriented. This is particularly pertinent for agriculture, given that the long-term investments needed to realize agricultural productivity gains in the future require a level of political attention and commitment that goes beyond the normal time span of a political cycle, and requires an environment where policy coordination is possible.

1.2 What can these studies tell us about African agriculture?

Many of the major forward-looking studies that have been done in the past, have given relatively coarse treatment to sub-Saharan Africa. This has arisen, due to a number of factors which we will name here. Firstly, the global nature of the assessment tools that are typically used for forward-looking economic analyses tend to require a fairly aggregated representation of regions, in order to maintain computational tractability. This, combined with the fact that Africa tends to have a relatively small share of global trade in agriculture, in terms of value, means that many researchers will want to either leave Africa as an aggregate region, or else combine it with other minor regions within the familiar residual representation known as 'rest-of-the-world'. In some cases, the relatively poor quality of agricultural statistics for individual African countries tends to encourage researchers to 'hide' such problems by adopting large-scale aggregations of the sub-continent, so that the influence of such statistical errors is reduced. In other cases, the attention of researchers is drawn away from Africa due to the fact that consumption growth in regions of East and Southeast Asia have been so much faster, and that the production and export potential of high-producing regions in Latin America has tended to dominate the global dynamics of agricultural markets and trade.

These reasons not-withstanding, there is still some useful information that can be had from existing forward-looking studies of African agriculture, despite its relatively crude and cursory treatment. In the following sections of the paper – we point to such studies and describe their key messages and shortcomings, so as to illustrate and motivate the need for improved foresight studies for the African region.

2. Overview of agricultural future studies

2.1 Forward-looking global assessments

Foresight exercises focused on assessing the future of agriculture are targeted at addressing stakeholder concerns regarding the future availability and pricing of agricultural commodities – among other issues. Over the last 50 years, there have been at least 30 quantitative assessments of future world food security, frequently released by the Food and Agriculture Organization (FAO) and the US Department of Agriculture (USDA), the Food and Agricultural Policy Research Institute (FAPRI) and occasionally by bodies such as the Organization for Economic Cooperation and Development (OECD), the International Food Policy Research Institute (IFPRI), and the International Institute for Applied Systems Analysis (IIASA) – among others.

The precise influence of each of these forecasts on policy debate is difficult to measure, however their creation and availability in such significant variety is a testament to their perceived usefulness (Lattre de Gasquet 2006). Two main models are often used in most examinations of the future of agricultural production and trade and these are trend projections (or extrapolations) and world market equilibrium trade models (McCalla and Revoredo, 2001). Trend projections used for example in a determination of food supply and demand balances, explore relationships between variables and indicators of interest, and are based upon a derived relationship that describes their evolution of time, that is derived from estimation upon available statistical series. Very simple trend projections might just consider the evolution of an indicator that is described by a single equation, although most take into account the interaction between relationships of supply and utilization across multiple commodities, as described by a system of equations. The system in question captures dynamics that were observed in past data, and uses this information to project future behavior – which presumes that there have been no major structural changes that might alter these relationships. As a result, these projections are most useful when attempting foresight into the short-term (one to five years) and the medium-term but only if they are constantly adapted (Griffon, 2004). The outlook reports that the USDA produces as commodity-specific forecasts, or the more global WASDE[1] report which gives a synthesis for world agriculture (USDA, 2012a), fall into this category. Some commercial firms, such as AgInforma, produce these kind of short-term outlooks for industry analysts, as market intelligence reports.

For more of a medium-term outlook (up to 10 years ahead), the USDA also produces a world agricultural outlook report (USDA 2012b), which focuses on the longer-term market trends that are of relevance to US Agriculture and its position in the world – and uses a combination of econometrically-based market equilibrium modeling, as well as the expert judgment of the World Agricultural Outlook Board. The Food and Agricultural Policy Research Institute (FAPRI) produces a very similar annual outlook report that follows a parallel time horizon, but which is more heavily-based on quantitative modeling (FAPRI 2011). However, while these more popular assessments can be grouped according the time-period of analysis, they are all quite similar in the sense that they are global assessments of the state of agriculture and do not go into much detail with regards to regional specifics. Key questions on the state of African agriculture, while touched upon in many of these global assessments, are not the primary focus and as such are not adequately addressed if at all.

The OECD/FAO Agricultural Outlook is also a medium-term assessment of agricultural markets covering cereals, oilseeds, sugar, meats, milk and dairy products over a 10-year period, and is a close parallel to both the USDA and FAPRI world agricultural market outlook assessments. The market analysis is based on a set of projections that are dependent on specific assumptions regarding macroeconomic conditions, agricultural and trade policies, production technologies and an assumption of average weather conditions. Using the underlying assumptions, the Agricultural Outlook presents a plausible scenario for the evolution of agricultural markets over the next decade and provides a benchmark for the analysis of agricultural market outcomes that would result from alternative assumptions (OECD-FAO, 2012).

Examples of longer-term assessments include FAO's World Agriculture to 2030/50 (FAO, 2006) assessment, which is an update on the earlier assessment to 2015/2030 (Bruinsma, 2003) – both of which follow a tradition of long-term perspective studies done by FAO for many years. These assessments, as is the case with the IFPRI long-term projections, are not done as frequently as the annual medium-term assessments of USDA and OECD-FAO – that serve as institutional flagship publications and are done in direct coordination with agricultural market

[1] WASDE = World Agricultural Supply and Demand Estimates

liaisons from national government(s). Other long-term assessments tend to be one-off exercises that are based on thematic treatment of particular issues of interest, such as the UK Foresight Report (GO-Science, 2009), the Millennium Ecosystem Assessment (MA, 2005), UNEP's Global Environmental Outlook (UNEP, 2007), and the International Assessment of Agricultural Science and Technology for Development (IAASTD, 2009). These are not easily replicated or repeated, since they involve a large number of stakeholders – whose interaction is necessary to define the trajectory of the important long-term drivers of change that will unfold over a 20-30 year period.

2.2 Key messages of these studies for Africa

The annual World Agricultural Supply and Demand Estimates (WASDE) published by the United States Department of Agriculture (USDA), is a shorter-term assessment that provides a comprehensive forecast of supply and demand for major U.S. and global crops and U.S. livestock. Providing a framework for related USDA reports, it is the product of data gathered from a number of statistical reports published by the USDA and other government agencies. While it briefly touches on impacts and projections involving the African region and one or two African countries, it also does not delve into more useful specifics. Primarily it states that global sorghum production is 0.7 million tons higher for 2012/13 with small increases for Australia, the United States, and several African countries, and corn and sorghum food use is higher in the same period for several African countries where these grains remain a staple food. Ending stock forecasts are however not made for the African region. Similar to the OECD- FAO study, USDA also shows an increase in global rice consumption of 0.9 million tons to a record 468.6 million, with most of the increase in China, India, and Nigeria, partially offset by decreases for Bangladesh, Egypt, and Tanzania. The assessment forecasts a reduction in ending stocks for Bangladesh and India but an increase for Nigeria. Wheat and soybean and corn ending stocks and are only detailed for North and South Africa respectively with projections for other African nations reported as a group labeled as the Southern Hemisphere or 'African Fr. Zone' with no country detail (USDA, 2012b). FAPRI is even less detailed short-term assessment that makes broad generalizations with regards to agricultural commodity production and consumption projections in Africa (FAPRI-ISU 2011).

Only one of the underlying assumptions and one trend projection in the OECD-FAO medium-term assessment is related to movement in African agricultural markets. The first is the assumption that growth in developing countries should increase the potential for south-south agricultural trade. This is attributed to the fact that income growth is closely related to population growth which is highest in regions like Africa (around 4% on average), and demand for higher-value agricultural commodities such as meat and dairy is more responsive to the rising incomes in these emerging economies than in mature markets. Therefore high growth developing countries, such as those in Africa, will lead most of the growth in imports of both processed and bulk agricultural commodities. The second is the commodity market trend projection that rice production is set to expand due to rice cultivation promotion polices which are targeted at supporting farmer incomes and limiting rural migration, and national and regional efforts to improve food self-sufficiency. Regardless of increased production and consumption the largest production gains are projected to come from major rice producers such as India, Indonesia, Thailand and Viet Nam (OECD-FAO, 2012).

The longer-term global assessments (i.e. MEA, UNEP-GEO and IAASTD) do a slightly better job in terms of coverage of African agriculture but they are still lacking in sufficient detail with regards to future country level projections for African agriculture. The International Assessment of Agricultural Science and Technology for Development (IAASTD) focuses more on the impacts of past, present and future agricultural knowledge, science and technology (AKST) on the fight to reduce hunger and poverty, the goal of improving livelihoods and human health and an equally applicable as well as socially, environmentally and economically sustainable formula for development. It is a global assessment but incorporates five sub-global assessments that focus specifically on North and sub-Saharan Africa, among other regions; therefore it contains some targeted regional analysis. It points out the great imbalance in numbers of AKST researchers per million inhabitants and that this number is 65 times smaller in Africa than in industrialized countries (IAASTD, 2009). The Millennium Ecosystem Assessment is also a global analysis which focuses primarily on the consequences of changes in the ecosystem on human livelihoods. It is a more scientific appraisal of movements within the world's ecosystem and provides a scientific basis for policy action targeted at its sustainable use and conservation. While the project includes sub global assessments, it only covers the South African region in its examination (MA, 2005). FAO's "World Agriculture to 2015/2030" report (Bruinsma, 2003), examines global prospects for food and agriculture including fisheries and forestry over the years leading up until 2015 and onwards until 2030. It details the global, long-term prospects for trade and sustainable development and discusses the issues at stake in these areas during the period of study. Its coverage of the outlook for Africa begins with the assumption that the population of sub-Saharan Africa reached 780 million by 2010 and per capita income growth will be approximately 1.8 per cent by 2015. Like the first few studied covered above, the FAO also relates food consumption patterns to increasing population and incomes as well as changes in dietary preferences and further estimates that population in sub-Saharan Africa will continue to grow by 2.1 per cent causing every third person added to the world's population to be sub-Saharan African. This is projected to further increase to every second person by 2050. Also the study points out that it is only in sub-Saharan Africa, where incomes are growing but at a very slow pace, that the number of those living in poverty is expected to rise from 240 million in 1990 to 345 million in 2015 with 2 out of 5 people in the region living in poverty (Bruinsma, 2003).

A summary of some of the major trends for Africa that are embodied in these longer-term studies are shown in Table 1 below.

Table 1: Summary of messages from long-term assessments

Consumption patterns	• Coarse grains (maize, sorghum, millet, barley, oats, rye and regionally important grains like *tef*) continue to serve as important foods in SS Africa, while used mostly for animal feeds elsewhere – and projected to grow faster than rice or wheat in consumption • Cons of roots, tubers & plaintains in decline elsewhere except SS Africa. Avg demand projected to rise in developing countries – with sweet potato & potato being important in animal feed • Per capita fish consumption may stagnate or decline in SS Africa (and NENA), with local wild stocks fully exploited and very little aquaculture
Land and resource use patterns	• Whereas yield improvements will account for 70% of production growth to 2030 (while land expansion is 20% and crop intensity changes are 10%) on a global level – SS Africa will rely more heavily

	on land expansion, with gradual shift to yield growth in future • More than 80% of arable area expansion is expected to occur in SS Africa and Latin America (North Africa, by contrast, has almost no area expansion) • Shares of irrigation remain small in SS Africa, in contrast to 14% increase in irrigation water withdrawals by 2030.
Production patterns	• Small scale farmers will continue to dominate the land scape for coming 20-30 yrs • The fastest growth rates for fertilizer consumption expected in SS Africa – though from very low level. Global consumption expected to grow at avg of 1% p.a. over next 3 decades.
Human well-being outcomes	• Average nutrition will fall slowly in SS Africa, with 15% of the population (183 million) remaining undernourished (only 11 million less than 1997-2000 levels) • By 2050 18 million of the 26 million added annual to world population will be in SS Africa • Climate change risk could depress cereal production by 2-3% by 2020/2030 and increase numbers at risk to hunger by 10 million

These global assessments provide an essential backdrop for stakeholders across the agricultural landscape, and although we do get some useful insight on some of the forces shaping African agriculture from these long-term, global assessments – we often don't get sufficient resolution on the diverse regions of Africa. Therefore, there is a need to examine assessments that are more specifically tailored to answering questions about what the driving forces are behind Africa's agricultural supply/demand dynamics

2.3 IFPRI baseline projections for Africa

IFPRI studies, starting from the book of Rosegrant *et al.* (2001), unlike those before it, provide more detail with regards to projections for Africa – specifically the sub-Saharan African region, for which a special set of scenarios to 2025 were done by Rosegrant *et al* (2005). One of the key recommendations for Africa, within this IFPRI study, was that of boosting technology change and productivity growth within agriculture, due to the observation that much of the production growth within the region came primarily from expanded cultivated areas rather than the use of fertilizer, improved varieties and better farming practices. The study surmised that this pattern would have to change in the future in order to maintain improved agricultural production. In the absence of such a transformation, however, the study projected that per capita income would fall, instead of rising slightly as in the baseline projection (Rosegrant et al. 2001).

Current baseline projections for Africa

Some more recent projections by IFPRI, based on the IMPACT model, show some interesting trends for African agriculture, that point to some of the regional differences in agricultural production and consumption growth – and their important underlying drivers. Even though the

IMPACT model disaggregates all countries in sub-Saharan Africa into separate regions – we present the results in 4 large regional aggregations for greater ease of exposition. The grouping of countries within these regions is included in Annex A of this paper (Table A1).

Overall there is steady growth in the indicators of supply and demand throughout the region with particularly fast-growing and rapidly urbanizing countries showing rapidly changing demand for meat products, which implies a corresponding need for animal feed. In terms of food security outcomes, most countries have an overall improvement in food security, over the period to 2030 – although mostly after recovering from a falling level of calorie availability to 2015. Positive gains in food security are partially offset by continued fast population growth to 2030. As a result, while per capita calorie availability in the region increases to 2030, the number of malnourished children also increases due to strong growth in the overall population size. We will return to a discussion of these results later.

2.3.1. Production growth

The profile of cereal production over time is shown in Table 2, and shows steady trends of output growth to 2030.

Table 2: Production of Cereals[2] ('000 mt)

(in 1000 mt)	**2000**	**2010**	**2020**	**2030**	**Avg. Annual Growth Rate (2000-2030)**
Western SSA	35,005	46,348	59,906	73,182	2.5%
Central SSA	3,929	5,301	7,374	9,418	3.0%
Eastern SSA	22,850	33,287	43,282	52,731	2.8%
Southern SSA	19,765	18,053	22,486	26,399	1.0%

Cereal production in SSA is projected to grow steadily across most of the region at a rate of about two percent per year with Western SSA clearly leading the region in cereal production volume (almost half of the total growth throughout the projection period). That said, Central SSA is expected to experience the fastest cereal production growth, attributable both to a combination of both the fastest cereal yield growth and the fastest cereal area growth.

Across these regions there is a strong contrast in irrigation patterns for cereals which reflects the differentials in output levels and productivity that are observed. The share of cereal production under irrigation for all regions within SSA is shown in Table 3, below.

Table 3: Share of Irrigated Area in Total Cereal Area

	2000	**2010**	**2020**	**2030**	**Avg. Annual Growth Rate (2000-2030)**
Western SSA	3.3%	4.1%	4.7%	5.3%	1.6%
Central SSA	0.8%	1.1%	1.2%	1.4%	2.0%

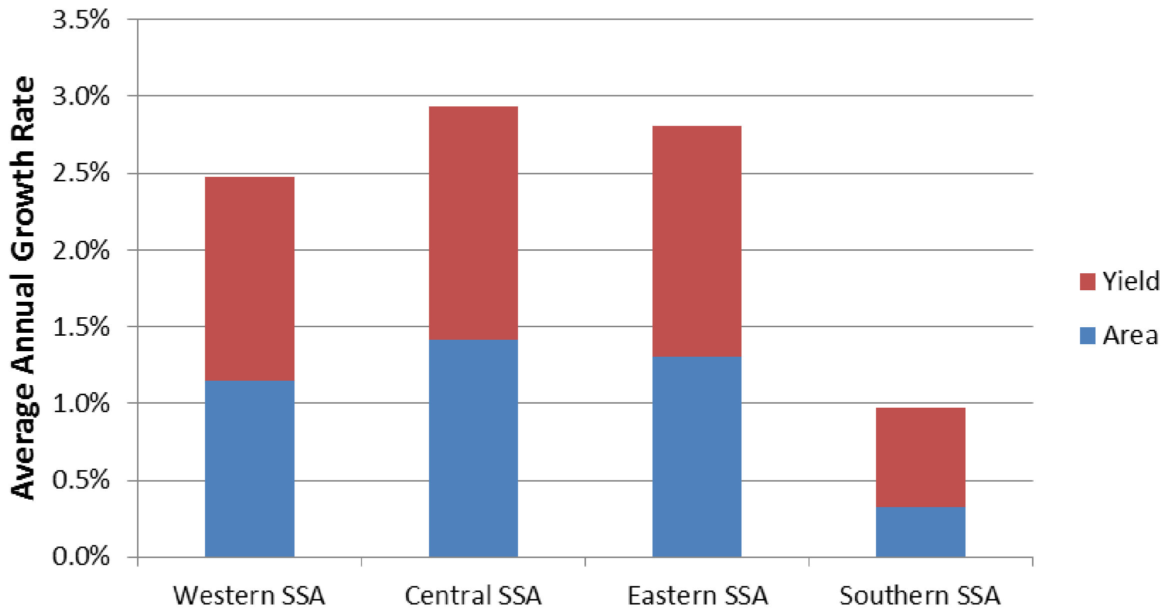
[2] The following crops are included in the 'cereals' aggregate: rice, wheat, maize, millet, sorghum and other miscellaneous coarse grains (barley, oats, rye, etc.)

Eastern SSA	8.1%	9.3%	10.0%	10.7%	0.9%
Southern SSA	5.7%	5.9%	6.5%	7.1%	0.7%

Western and Eastern SSA are regions with the strongest irrigation systems and records of irrigation expansion. However, even in these regions (as well as in Southern SSA) some countries have no irrigation systems at all. The SSA region as a whole is projected to increase the share of irrigated cereal area from just under five percent in 2000 to almost sever percent in 2030.

Looking more closely at the sources of production growth for these cereal commodities (Figure 4), we see that in most regions, a slightly larger share of growth in production will come from yield growth rather than area expansion.

Figure 4: Sources of Production Growth for Cereals to 2030



This stands in contrast, however, to the overall 70% share of yield gains in total production growth that FAO has projected as being necessary to meeting future food needs (Bruinsma, 2003; FAO, 2006). Most regions have between 1.2 and 1.4 percent annual growth in cereal area and around 1.5 percent annual growth in yield. Table 4. shows the gradual growth in harvested area for cereals and Table 5. shows the average yield levels for cereals.

Table 4: Harvested Area of Cereals ('000 ha)

	2000	**2010**	**2020**	**2030**	**Avg. Annual Growth Rate (2000-2030)**
Western SSA	38,822	45,349	50,432	54,712	1.2%
Central SSA	4,715	5,863	6,581	7,185	1.4%
Eastern SSA	22,006	26,577	29,740	32,448	1.3%
Southern SSA	12,019	11,962	12,748	13,259	0.3%

Table 5: Average Yield of Cereals (mt/ha)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	0.9	1.0	1.2	1.3	1.3%
Central SSA	0.8	0.9	1.1	1.3	1.5%
Eastern SSA	1.0	1.3	1.5	1.6	1.5%
Southern SSA	1.6	1.5	1.8	2.0	0.6%

Southern SSA sees a more limited growth in both area and yield of cereal crops. This is due to the fact that the region already starts from a relatively high level of cereal yields, in year 2000, and also because of an actual cereal area decrease to 2030 in Botswana, South Africa and Swaziland and slow growth in several other states. This is a common pattern across many regions where the availability of high-quality land is limited by geography and topology. In a country like South Africa, which has a strong agricultural sector, intensification tends to be chosen as a growth strategy over continued extensification of land holdings. Root and tuber commodities also form a key component of staple consumption within much of the SSA region, and is show to have even slower growth in area (Table 6) and yield (Table 7).

Table 6: Harvested Area of Roots and Tubers[3] ('000 ha)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	10,249	12,154	12,801	13,638	1.0%
Central SSA	3,114	3,487	3,761	4,016	0.9%
Eastern SSA	4,326	4,852	5,147	5,388	0.7%
Southern SSA	2,248	2,774	2,945	3,102	1.1%

Table 7: Average Yield of Roots and Tubers (mt/ha)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	9.0	10.7	12.4	13.8	1.4%
Central SSA	7.4	6.6	7.6	8.6	0.5%
Eastern SSA	7.1	7.1	8.3	9.7	1.1%
Southern SSA	8.0	10.7	11.9	12.5	1.5%

Similar to the pattern seen for cereals, IMPACT also projects steady growth in meat production (Table 8).

[3] The following crops are included in the 'roots & tubers' aggregate: Irish potatoes, sweet potatoes and yams, cassava, and other assorted root & tuber crops (taro, etc.)

Table 8: Production of Meat[4] ('000 mt)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	1,895	2,447	3,635	5,051	3.3%
Central SSA	455	571	841	1,143	3.1%
Eastern SSA	2,479	2,763	4,077	5,570	2.7%
Southern SSA	2,228	2,724	3,606	4,497	2.4%

The stable growth of meat production across all of SSA results in total production more than doubling by 2030 and reflects the rapid socio-economic and demographic growth that is expected to take place in the region. It is worth noting that the rate of growth of meat production outpaces that of cereals, roots and tubers and oil crops – and points to the importance and strong potential within this sector, for Africa.

2.3.2. Consumption growth

Consumption growth over the thirty-year period for total food demand for cereals is projected to increase (Table 9) approximately in proportion to the projected increases in population that occur over the same time period, essentially doubling.

Table 9: Total Food Demand for Cereals ('000 mt)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	32,466	41,496	56,565	74,909	2.8%
Central SSA	4,741	6,216	8,532	11,426	3.0%
Eastern SSA	24,708	32,176	43,787	57,419	2.9%
Southern SSA	16,817	19,860	23,888	28,295	1.7%

This is further confirmed in Table 10 that shows relatively little change in per capita food demand for cereals between 2000 and 2030.

Table 10: Per Capita Food Demand for Cereals (kg/capita/year)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	138	137	144	151	0.3%
Central SSA	58	58	62	68	0.5%
Eastern SSA	107	107	113	119	0.3%
Southern SSA	143	141	141	141	-0.1%

The per capita consumptions of roots and tubers (Table 11) is also stagnant or falling in much of the SSA region.

[4] The following crops are included in the 'meat' aggregate: beef & buffalo meat, poultry meat, pig meat and that from sheep and goats. No milk or egg products are included in this category.

Table 11: Per Capita Food Demand for Roots and Tubers (kg/capita/year)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	188	184	182	174	-0.2%
Central SSA	250	248	243	233	-0.2%
Eastern SSA	106	108	111	112	0.2%
Southern SSA	105	116	122	124	0.6%

On the other hand, food demand for meat is projected to rise rapidly both in absolute (Table 12) and per capita terms (Table 13).

Table 12: Total Food Demand for Meat (‘000 mt)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	1,999	2,821	4,274	6,336	3.9%
Central SSA	538	762	1,134	1,647	3.8%
Eastern SSA	2,385	3,356	4,994	7,144	3.7%
Southern SSA	2,395	3,014	3,767	4,725	2.3%

Table 13: Per Capita Food Demand for Meat (kg/capita/year)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	8	9	11	13	1.4%
Central SSA	7	7	8	10	1.3%
Eastern SSA	10	11	13	15	1.2%
Southern SSA	20	21	22	23	0.5%

In fact, in per capita terms, food demand for meat is projected to grow faster than per capita demand for any other reported commodity, incl. cereals, roots and tubers and oil crops. This increase represents a projected change in diets and shift in preferences towards meat caused by rising incomes in the region.

2.3.3. Implications for Food Security and socio-economic growth

The patterns for supply and demand over time have implications for human security and welfare that we track through indicators of energy availability from food (measured in caloric terms) and exogenous ‘drivers’ of socio-economic and demographic growth. These drivers conform to a “business-as-usual” or baseline set of assumptions, where historical patterns of change in key drivers of socio-economic growth (income and population) are assumed to persist and there are no significant increases in levels of agricultural technology investments. Tables 14 through 16 show the projected trends in population and income for the SSA regions with many regions projected to have solid income growth over the projection period. The fact that Southern SSA starts at a much higher level of total and per-capita income, compared to other regions, its rate of growth over this period seems lower – but maintains a steady trajectory, nonetheless.

Table 14: Population (millions)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	235.3	303.8	391.8	495.5	2.5%
Central SSA	82.1	107.4	136.7	169.0	2.4%
Eastern SSA	230.9	300.5	386.7	483.4	2.5%
Southern SSA	117.5	140.8	169.3	201.1	1.8%

Table 15: Income (billion constant Y2000 US $)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	79.6	122.6	206.0	350.2	5.1%
Central SSA	28.2	43.1	74.2	130.6	5.2%
Eastern SSA	46.3	74.8	134.3	244.2	5.7%
Southern SSA	221.9	315.9	428.1	610.6	3.4%

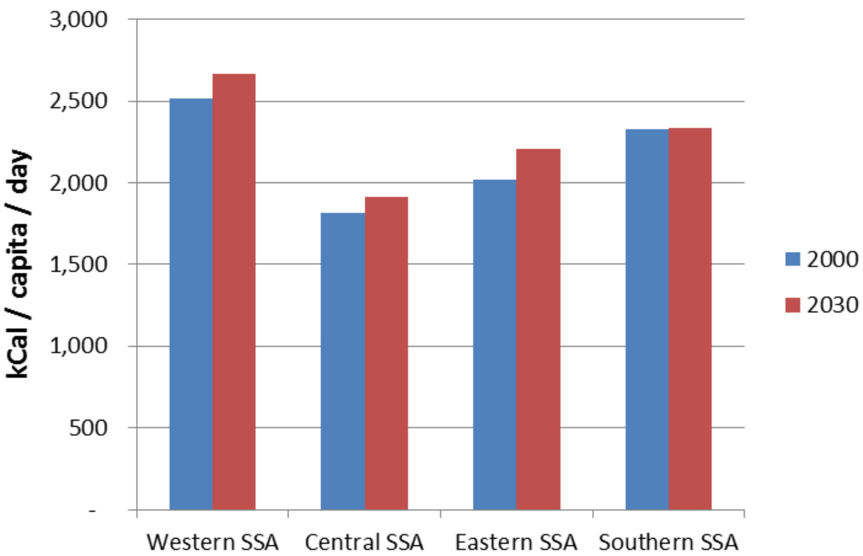
Table 16: Per Capita Income (constant Y2000 US $/capita/year)

	2000	2010	2020	2030	Avg. Annual Growth Rate (2000-2030)
Western SSA	338	403	526	707	2.5%
Central SSA	343	402	543	773	2.7%
Eastern SSA	200	249	347	505	3.1%
Southern SSA	1,888	2,244	2,529	3,036	1.6%

In contrast to other regions, Eastern SSA region is expected to experience the fastest per capita income growth in all of SS Africa – although it is starting from the lowest level.

The impact of these changes in consumption patterns, which also include a broader range of food commodities, on the overall per capita calorie availability to 2030 is shown in Figure 5.

Figure 5: Per Capita Calorie Availability to 2030



In this figure, we see that all regions increases their average per capita levels of food availability to 2030 – although, after having experienced a 'dip' in the intermediate period to 2015. (The increase in food availability in Southern SSA, however, is only marginal.) This illustrates the difficulty that countries in this region will have in meeting the 2015 MDG goals for hunger and poverty – although the prospects for recovery and subsequent improvement are there. A few countries (Liberia, Benin, Niger, Lesotho, Malawi, Zimbabwe) show a lower 2030 availability level, even after the intermediate 'rebound' from the 2015 levels occur – and should be noted as regions in need of further attention by policymakers both within the region as well as those within the wider development and aid community. Some countries experience steady growth and improvement in their food availability, such as Ghana and Uganda – while others seem to maintain a near 'balance' or match between their 2030 levels of food availability, and those in the base year (2000). This shows the need for action and policy efforts so as to lessen the depth of the downturn towards 2015, so that they can realize faster improvements in human wellbeing towards the middle of the century.

Main messages from the IFPRI projections

While there are countries within the region that perform well – others are in danger of falling far below the levels of human well-being improvement that are required to meet important development goals. The rapid socio-economic change that is anticipated to occur in the region, over the period to 2030 will not automatically translate to higher levels of production growth and increased food security, without concerted efforts to maintain investments in the agricultural sector, and in the infrastructure that supports it – primarily roads and marketing/processing/distribution mechanisms. The increased demand for livestock and crop commodities in other rapidly-growing regions of the world – such as south and east Asia could represent an opportunity for countries in this region that are able to take advantage of future export opportunities, while also meeting their own internal food needs.

The IMPACT results underscore the importance of engagement, within this region, with the CAADP process and other regional economic development initiatives that are aimed at promoting an agriculture-led development strategy. Such a strategy can serve to reduce household poverty and malnutrition, boost rural incomes, increase labor productivity and free up resources that can be mobilized in other sectors, so as to enhance the value-added that agriculture can generate and contribute towards overall economic growth.

2.4 Key knowledge gaps about Africa's agricultural future

While these medium- to long-term studies have helped to illuminate some of the broad trends that will shape the patterns of agricultural production, consumption and trade across Africa – there are still a number of important areas of uncertainty about Africa's agricultural future. While we are broadly aware that socio-economic change – in the form of population and income growth – will have important implications for future consumption patterns in Africa, the role that the dynamics of urbanization plays remains somewhat unclear. Much of the migration towards cities, in Africa, results in the accumulation of low-paid workers living on the urban fringe, who are clearly not as likely to contribute towards the growth in consumption necessary for creating backward linkages and boosting agricultural productivity in the rural sector.

The increase of commercial investment interests in Africa also poses an opportunity for growth within the agricultural sector, given that many of these investor interests originate from outside Africa and are focused on producing agricultural products for export. These commercial ventures have raised concerns over the way in which land concessions were made, and have been closely studied by those who wish to understand the implications of these large-scale acquisitions – termed ‘land grabs’ by some – for local smallholders (Deininger and Byerlee, 2011; Deininger *et al*, 2011). Some have argued that the attempt to create ‘super farms’ in Africa, on the basis of these types of outside-driven agricultural investments are not as beneficial as other types of investments and interventions that can boost the on-farm productivity in Africa and create a more organic process of farm consolidation and production intensification (Collier and Dercon, 2009). Some of these commercial interests are more ‘home-grown’, however, and constitute an increasing level of vertical integration that is occurring in the more advanced agricultural economies of Africa with growing agribusiness operations, such as Southern Africa (BFAP, 2012). The extent to which these kind of agribusiness-oriented investments and transformations of the food value chain will spread across the various regions of Africa, in future, is a point of uncertainty and intense research interest.

Many of the agricultural assessments that we have discussed deal mostly with Africa’s trade connections with the rest of the world – but have relatively little to say about the dynamics of intra-regional trade between African countries. The fact that many African countries are land-locked and face high costs of transaction and shipping, mean that they must rely upon their nearest neighbors for their supply of agricultural and non-agricultural goods. Many of the secondary statistics that are available for analysis do not adequately capture the quantities of intra-regional trade that occur in Africa – although individual studies have pointed to their significance, vis-à-vis international trade linakges (Binswanger-Mkhize et al, 2009). This remains, therefore, an often poorly understood dimension of African agricultural trade dynamics in forward-looking studies.

In the following section, we examine a number of studies which have tried to uncover greater detail about the nuances of African agricultural futures that is often overlooked in more global studies, and bring out some of the key drivers of change that are relevant to understanding how future market dynamics might evolve in Africa.

3. Towards better foresight for African agriculture

3.1 Examples of forward-looking regional studies for Africa

Here we describe some examples of where strong efforts are being made to understand the key drivers of agriculture for specific sub-regions of Africa. These studies help exemplify the kind of work that needs to be carried out at a sub-continental scale to better understand the trends and drivers that will determine Africa’s agricultural future, and fill in some of the knowledge gaps that we pointed out earlier.

Assessment of South African agricultural futures

Some examples of African centered assessment of food and agriculture include the Baseline Agricultural Outlook conducted by the Bureau for Food and Agricultural Policy (BFAP, 2012), and the reports done for the ECOWAS region by the Sahel and West Africa Club affiliated with the OECD (SWAC-OECD, 2011a, 2011b, 2011c). These are focused studies on the future of food security in Africa some analysis at the regional and country level.

BFAP presents a projection of South African agricultural production, consumption, prices and trade from 2012 through 2021. Generated by the BFAP sector model, projections are based on a series of assumptions about economic, technological, environmental, political, institutional and social factors. The baseline as constructed and utilized in the assessment is not intended to be a forecast but a glimpse of potential outcomes based on the assumptions that oil prices will stagnate or decline, global and SA economic growth rates will remain low, there will be a gradual depreciation in exchange rates, markets will experience high world agricultural commodity prices over the medium term with a declining trend in the long run, real gross income in SA within the agricultural sector will show strong growth in 2012 and 2013 but will decline in the long run, there will be increased field crop production despite stagnation in production areas due to increased intensification, there will be consistent intensification and expansion of meat, eggs and dairy however domestic production will likely not meet the growth rates of the past decades, and that horticultural production will remain stable over the study period with growing export parity due to dampened exchange rates (BFAP, 2012).

Some important messages which come out from this study, are summarized in Table 17 below.

Table 17: Summary of messages from BFAP outlook for South Africa

Consumption patterns	• Consistent demand growth expected from population trends • Demand for potatoes and wheat-based products projected to growth by 18 and 20%, respectively, while that of maize meal remains stagnant • Demand for been expected to grow at annual rate of 3% p.a., following incr in real disposable income and livestock production
Resource use patterns	• Resource constraints will continue to heavily revolve around land and water availability
Production patterns	• Sources of increased production likely to come from intensification and not land expansion
Market environment	• Commodity market movements will be greatly influenced by linkages with energy markets • Slowed domestic and global economic growth will have significant impact on exchange rates – with SA rand remaining strong with very gradual depreciation • Uncertainty will persist over policy environment with market deregulation and changes in trade tariff regime

Other sources of uncertainty surrounding the South African government’s biofuel policy, which whose industrial strategy was first published in December 2007. Given that the current level of biofuel production from agricultural commodities is negligible, it is likely that the government will introduce a mandatory blending rate of 2 % -- however there are no details on when and how this will be introduced.

Assessments of key drivers in West African agriculture

Agreement among the Sahel West African Club member countries in 2010 put food security as a major theme for2011-2012 plan for West African futures through 2050 and in collaboration with OECD, the agreement has resulted in the production of a series of reports geared towards informing regional strategy and policy. The resulting work is primarily concentrated on the role of population settlement and market dynamics as both topics relate to food security. Analysis of the relationships between these phenomena lent a different dynamic to food security policy design and implementation. Although the result of the collaboration included some projections, this was not the main goal of the study. Rather the focus was on the production of policy options on how to better account for the interactions between the above factors when designing and implementing agricultural policy. Specifically the resulting reports highlight the fact a correlation exists between the rapid and powerful settlement dynamics in West Africa and the region's food insecurity characteristics therefore, there is a need to develop adequate food security policies and strategies, regional markets have a direct and/or indirect effect on food security and based on projections of settlement evolutions, identification of regional market dynamics and their link with food security strategy, policy options confirming the importance of the integration of both factors with food security analyses and will promote regional policy synergies (SWAC –OECD, 2011).

The SWAC-OECD also highlights the link between economic growth and urbanization in a food security context. In its third installment, the SWAC study build on a prior world bank World Development Report conducted in 2009 which essentially states that economic development derives to a large extent, from the exploitation of economies of scale and the movement of goods and services across space. Therefore, changes in population spatial distribution and urbanization are oftentimes a larger determinant of growth than natural resources and endowments, and the concentration of activities and people, the decline in the cost of transportation and the removal of all barriers to the free movement of people, goods and information are all key contributors to economic development (Hitimana et al. 2011a). West Africa has been experiencing intensive urbanization for more than fifty years. This urbanization has affected the region's largest towns and small urban centers alike. The average distance between agglomerations has declined from 111 km to 33 km. However, urbanization rates vary widely across countries. The evolution of the region's urban systems relates to the rise in the ratio of non-food-producers (consumers) to food-producers. This trend contributes to the spatial organization of supply and demand and must be taken into account in food security policies and strategies.

Currently, according to the report, West Africa is has still not reached a state of over-urbanization, and urbanization has mostly occurred through the formation of a network of small and medium-sized towns and cities. These towns provide the essential hubs for the spatial organization of domestic markets and are the "connective tissue between rural and urban areas. They act as market centers for agricultural and rural output, as stimulators of rural nonfarm activity, as places for seasonal job opportunities for farmers, and as facilitators of economies of scale. Towns draw sustenance from the agricultural activity of rural areas, but their prosperity also spills over to villages by providing nonfarm employment opportunities" (Hitimana et al. 2011c).

3.2 Data issues and methodological challenges

One of the common challenges that is often faced by researchers doing work on African futures, is that of data – which can be a barrier to establishing a reliable picture of the present situation, so that the future pathways can be traced with more confidence. Some of this uncertainty comes from the basic agricultural statistics that are needed to establish the patterns of production, consumption and trade for various countries in Sub-Saharan Africa, and which are the bread-and-butter indicators of any agricultural assessment. While much of these data can be obtained from FAO's extensive agricultural database, the veracity of some numbers can be highly questionable – especially when it comes from countries with conflict and or weak national systems of statistics (e.g. Somalia, Equatorial Guinea, Djibouti, Eritrea, among others). Some of the uncertainty can come from even the most basic socio-economic indicators like population growth, which the UN Statistics Division produces routinely for all countries of the world. The measurement of urban population – in particular – can be particularly problematic. The first installment of studies on West African Futures (Hitimana et al, 2011a) identifies the key fact that urbanization trends in West African initially began at a rapid pace which began to slow at varying rates in different countries. The second installment however points out that this information is only useful if measurements of urban population movements in either direction are based on a standard means of measurement and a predefined uniform definition. It points out that the data which underlies urbanization trend reporting should be such that will allow for accurate comparison between countries. This is possible only if the underlying data is uniform, therefore there is a need to work towards consistency and harmony in settlement data within the region (Hitimana et al. 2011b).

4. Major drivers of change in African agriculture – insights from an expert consultation

In October 2012, a small consultation was held to discuss the critical drivers of change in Africa agriculture, among a group of experts who engage in forward-looking assessments of agriculture. One of the major aims of this consultation was for regional experts to compare notes on important trends within their respective regions, and obtain insights from the works of their peers in how they tackle similar issues. Some common issues of methodological and data challenges were brought up, as well as a set of key insights that apply to broadly to the future development of African agriculture, across the sub-continent. We will now summarize these insights, thematically, in order to convey some of the important messages that emerged from this consultation.

Urbanization

One of the themes which came out very strongly, during this consultation, was that of urbanization and its implications for food demand in sub-Saharan Africa, and overall socio-economic change. The expert analysis of West Africa, in particular, drew attention to this trend of urbanization, as being one of the main features that's shaping the landscape of agriculture in that region. Although it is sometimes problematic to get a consistent definition of urban and non-urban areas within Africa, sources such as AFRIPOP have made an effort to do some harmonization of information, so that a better view of what's happening in the sub-continent can be obtained. The importance of urbanization is also echoed in the discussion of urban growth and its relation to agriculture, in the recent evaluation of African infrastructure by the World Bank and the African Development Bank (Foster and Briceño-Germendia, 2010). In this study, they point out that the growth of urban centers provides a strong pull from the rural areas that are close to it – termed the 'rural hinterland', by then. They note that almost 85% of Africa's agricultural production comes from this 'rural hinterland' – comprising regions within 50km of an urban center – and points to a close connection between patterns of socio-economic change and the demand for agricultural products from the rural sector.

Agribusiness

Another important driving force in African agriculture, is that of agribusiness investments, and the growing commercialization and value-addition occurring in retails chains all over the African continent. The expert assessments from Southern Africa, in particular, showed the steadily increasing influence of large agribusiness concerns, and the effects that they have on the mix of agricultural crops that are grown in the region, and the levels of productivity and quality that are demanded from suppliers by large agribusiness operations. In other parts of sub-Saharan Africa, the influence of agribusiness-driven concerns is felt mostly through the interest that outside investors have to obtain land and resources to set up large-scale commercial farming enterprises, that focus on particular crops of interest – such as biofuel feedstock crops, or high-value products that can earn high export revenue. Some of the concerns surrounding large-scale land-acquisitions (termed 'land-grabbing' by some in the literature), come from observations of how these outside agribusiness-oriented enterprises have gone about obtaining long-term concessions of land from national and local governments, often without the unanimous consent or prior knowledge of local residents. A great deal of work is being done to look into the actual extent of these type of land acquisitions, so as to better understand the origins of the investment purposes, and to determine how much of them constitute real acquisitions, as opposed to investor intentions which have been announced through local or international media.

Within the consultation, there was recognition that more needs to be done to strengthen governance of land (among other institutions) within sub-Saharan Africa, to prevent the loss of resource access by vulnerable people in regions with high investor interest. At the same time, the potential role of agribusiness in boosting the productivity and profitability of the farming sector – either through enhanced retail volume, greater value-added or the beneficial transference of technology, inputs and resources to farmers -- was recognized, and was deemed to be an important dimensions of African agricultural growth in the future.

Climate Change

Within the consultation, a number of experts pointed to the influence and impact that future climate change (and increases in current levels of climate variability) would have on the future of African agriculture. Given the relatively low levels of irrigation investment in many regions, the ability to buffer changes in rainfall levels is relatively limited, and exposes farmers to a high degree of vulnerability. For some regions, the threats of future climate change are manifest in potential decreases of rainfall and increases in temperature. For other regions, the main threat that climate change poses is that of increased frequency of dry weather events – regardless of what the overall seasonal average of precipitation might be. In wetter regions, the possibilities for increasingly strong flood events poses a large threat to agriculture (and other sectors), especially where the infrastructure and capacity to store and control flows of surface water are limited. For this reason, the infrastructure report of Foster and Briceño-Germendia (2010) points to investments in dams and reservoirs as being necessary not only for power generation, but also to manage the flow and volume of surface waters that are expected to be more variable in their streamflow over the coming decades.

Besides these drivers, it was also noted that the rapid penetration of information and communications technology (ICT) is likely to deepen and bring spill-over benefits to agriculture. The infrastructure analysis of Foster and Briceño-Germendia (2010) also pointed to the relative success of ICT in terms of its adoption in Africa, relative to other types of technologies, and that the remarkable rates of usage, even across the poorest types of households. Now that farmers are able to contact trading partners and associates in far-off places, in order to verify the levels and movements of prices, they are better able to avoid middle men and additional transactions costs in sale, and to exploit arbitrage opportunities. This is likely to lead to more integrated markets, and greater benefits for producers, as they are able to capture more of the final value of their goods.

5. Conclusions

In this paper, we have examined a number of different forward-looking assessments for agriculture, in order to better understand how gaps in the knowledge about Africa’s agricultural future can be best filled. Many of the global assessments of agriculture tend to give too coarse of a view of African agriculture to be very useful, and fail to address the heterogeneity and breadth of Africa’s varied agricultural landscape and the drivers that are at work within its food systems. Africa’s relatively small share of global traded volume in agricultural products tends to dissuade many researchers from looking in great detail at the continent, and leads to gross generalizations about trends of African agriculture in the future.

While many of the main messages coming from medium- to long-term assessments of African agriculture show steadily increasing levels of production growth – a smaller share of production gains come from yield gains, as compared to other regions, and the irrigation potential for many regions remains largely under-exploited. Broadly-speaking, the per capita levels of food consumption for higher-value foods like meat is expected to increase much faster, compared to other categories of staple foods, although they start from a much lower level, compared to other regions in the world. Whereas other regions consume coarse grains mostly as animal feeds, these grains remain important food crops in sub-Saharan Africa, although their rate of per capita consumption growth is small. The consumption growth for roots and tubers, by comparison, are even smaller, and are projected to decline in the Western and Central regions of Africa.

A much more nuanced understanding of Africa's agricultural future is needed, however, to appreciate the diverse set of drivers that are likely to shape the trajectory of production, consumption and trade on the continent. A number of Africa-focused foresight efforts have been underway to uncover the importance of urbanization, agribusiness penetration, technological change and climatic influences in selected regions of Africa. An expert consultation helped to clarify the importance of these policy-related and socio-economic drivers of change on future evolution of market conditions. The data problems that obfuscate the real rates of urbanization in regions of Africa, are being addressed by efforts to harmonize data across the region, so that definitions of urban settlement are applied uniformly. Other data issues, such as those relating to the extent of intra-regional trade in Africa, will require a more concerted effort to address for the whole continent, although better sources of this now exist for some regions.

If future planning and investments for Africa's agricultural growth is to advance – then both the data and methodology that allow us to do informative foresight-based assessments for agriculture will have to improve accordingly.

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Annex A: the IMPACT model

In this annex, we present some details that are useful for understanding the outputs of the IMPACT model of IFPRI.

Table A1: Mapping of States in Sub-Saharan Africa into Reporting Regions

Western SSA (ECOWAS+)*	Central SSA	Eastern SSA	Southern SSA
Benin	Cameroon	Burundi	Angola
Burkina Faso	C.A.R.	Djibouti	Botswana
Cote d'Ivoire	Chad	Eritrea	Lesotho
Gambia	Congo	Ethiopia	Malawi
Ghana	D.R.C.	Kenya	Mozambique
Guinea	Equatorial Guinea	Madagascar	Namibia
Guinea Bissau	Gabon	Rwanda	South Africa
Liberia		Somalia	Swaziland
Mali		Sudan	Zambia
*Mauretania**		Tanzania	Zimbabwe
Niger		Uganda	
Nigeria			
Senegal			
Sierra Leone			
Togo			

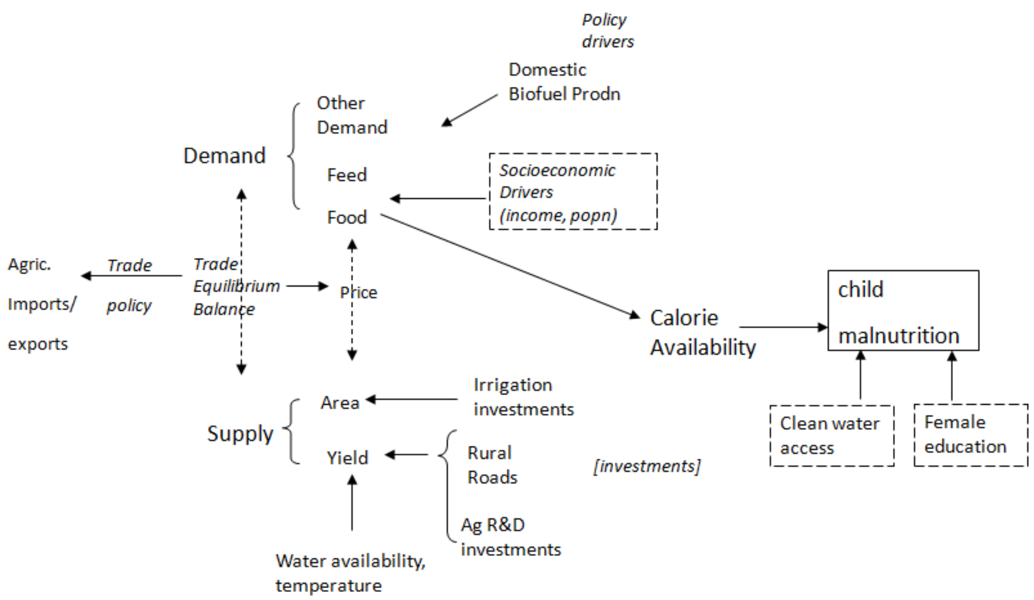
* The Western SSA region contains all member states of ECOWAS plus Mauretania.

IFPRI's IMPACT model

The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) was developed in the early 1990s as a response to concerns about a lack of vision and consensus regarding the actions required to feed the world in the future, reduce poverty, and protect the natural resource base (Rosegrant et al., 1995). In 2002, the model was expanded through inclusion of a Water Simulation Model, as water was perceived as one of the major constraints to future food production and human well-being (Rosegrant, et al., 2002; Cai and Rosegrant, 2002; Rosegrant and Cai, 2002). This augmentation led to the name "IMPACT-WATER", although it is still refered to as IMPACT in other descriptions.

The results discussed here were generated by IFPRI's current IMPACT model. The IMPACT model is a global, partial-equilibrium, agricultural multi-market model – that simulates the supply, demand and trade dynamics of major agricultural commodities over a 30-50 year time horizon. The interaction between food production and water availability is modeled, so that the implications of increasing water demand for non-agricultural uses can be examined, in terms of its trade-offs with irrigation water availability. This is done by linking the yield levels of irrigated crops with the outputs of a water simulation model that allocates available water – under alternative climate outcomes – across agricultural and non-agricultural sectors. The water model is based on state-of-the-art global water databases and models (including GTAP data on non-agricultural water use and University of Kassel irrigation data), simulating integrated basin management, field water management, and crop water use. Water supply in irrigated agriculture is linked with irrigation infrastructure, permitting estimation of the impact of investment on expansion of potential crop area and improvement of irrigation systems. The schematic shown below (Figure A1), illustrates the linkages between the various modeling components.

Figure A1: Schematic representation of the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)



This framework allows exploration of the relationship of water availability to food production, demand, and trade at various spatial scales - from river basins, countries, or regions, to the global level - and time horizons. IMPACT divides the world into 115 regions, which are intersected with 126 river basins, to represent the significant climate and hydrologic variations that are observed across them. This intersection of countries and basins gives rise to 281 spatial 'food-producing' units that enable us to simulate agricultural supply response at the sub-country level so as to further enhance our understanding of environmental constraints to future agricultural growth.

Further details on the IMPACT model can be found on the IFPRI website:
http://www.ifpri.org/book-751/ourwork/program/impact-model