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Capacity Development for Modernizing African Food Systems (MAFS) Working Paper

Food System Dynamics:
Anticipating and Adapting to Change

By

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The Modernizing African Food Systems (MAFS) Consortium



Modernizing African Food Systems (MAFS) Consortium

Objective: The MAFS Consortium aims to help African agricultural education and training (AET) institutions develop the technical skills and institutional capacity required to modernize African food systems.

MAFS Consortium Members:

- Makerere University
- Michigan State University
- Stellenbosch University
- University of Pretoria

Activities and Outputs: The MAFS Consortium has assembled a technical team from four major agricultural universities to produce a series of empirical background studies that will provide evidence necessary for informing capacity development efforts in African AET institutions. Substantively, the activities center around the following four thematic areas.

Theme 1. Food System Dynamics in Africa and Consequent Skill Requirements in the Private and Public Sectors

Theme 2. Models of AET Engagement with Private and Public Sector Employers

Theme 3. Existing Capacity of African AET: Case studies of African universities with regional footprints

Theme 4. Impact of past AET institution-building efforts in Africa

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ABSTRACT

This paper underscores the scope and nature of needed responses to the rapidly changing food systems in Africa. The paper identifies key drivers of this change and estimates their magnitudes. The drivers identified are urbanization, per capita income growth, globalization and climate change. Emphasis is laid on the former two largely because these are drivers of predictable change.

The findings show that Africa's food consumption patterns will change dramatically over the next four decades. Urbanization will increase three-folds in the next 40 years and will outstrip the rural population. Together with a growing per capita incomes of about two percent per annum, urban marketed food will increase six-folds, ramping up demand for packaged convenience foods and requiring substantial private sector investment in food processing technology. The tertiary agricultural education and training institutions will need to respond to these changes by offering skills in the respective fields like food packaging, logistics, supply chain management, food hygiene, etc. as opposed to being content with the traditional lower level value chain skills.

As urbanization increases, consumption of cheap, high starch, low micronutrient foods will become more widely consumed contributing to overweight, obesity, diabetes and hypertension disorders. These will require both private sector and government policy responses to raise awareness and educate the population in order to reduce these negative impacts.

Key words: Africa, change, food, systems, adapt

1. INTRODUCTION

As stated by the philosopher Heraclitus 535-475 BC, nothing is permanent but change. The changes in the African food systems are catching our attention more now than ever before because of their magnitudes and the speed at which they are occurring. Africa's food system will change dramatically over the coming decades. These dynamics – and the problems and opportunities they present -- need to be understood so that proper responses from a variety of actors can be crafted to ameliorate the likely negative effects and take advantage of the opportunities for improved incomes, lower poverty, and more healthy, accessible, and affordable food for growing populations.

2. DRIVERS OF CHANGE IN THE AFRICAN FOOD SYSTEM

Many factors are driving change in African food systems. Among those most often discussed are climate change and globalization. These are external forces of change to which Africa must adapt. In this paper we focus on two major internal drivers of change that have only recently begun to receive attention: population growth, especially growth in urban populations, and per capita income growth, much of which is concentrated in urban areas.¹

Africa has the highest urban population growth rate of any developing area. With some variation across on the continent, urban population is increasing about three percent per year. Growth at this rate will triple the urban population in the next 40 years, outstripping rural population by far and driving the urban population share well above 50% (Figure 1). Africa has also seen robust per capita income growth since 2000. After posting the lowest growth of any region in per capita purchasing power parity incomes during the 1990s, SSA achieved total growth of 59% during the 2000s, higher than in Latin America and the Middle East plus North Africa; eleven SSA countries ranked among the top 30 across developing SSA, Latin America and Caribbean, and Asia in per capita GDP growth during this period².

Together, these two trends will more than triple the marketed volumes of foodstuffs over the next 40 years and ramp up demand for high-value foods (dairy, meat and fresh fruits and vegetables), processed foods, packaged convenience foods and prepared foods (Figure 2). As fewer farm families support growing urban populations, farm productivity will need to increase in both crop and livestock production. Growing demand for packaged convenience foods will require substantial private sector investment in post-harvest systems and food processing technology.

¹ Climate change is a fundamentally different dynamic than those we are considering in this paper. Globalization, while an external force, is more similar. Africa has been seen as a laggard in opening to globalization, but the urbanization and per capita income growth now taking place will change this; together they will drive changes similar to those seen in globalization and will at the same time open African economies to greater impacts from globalization, further increasing the already rapid rate of change

² Based on most recent World Bank data on per capita purchasing power parity income, downloadable from their website.

3. RESULTING CHANGES IN FOOD CONSUMPTION PATTERNS

The trends documented above will drive transformative changes (a) in food consumption patterns and (b) in the structure of food systems needed to serve them, with important implications for the human skills that these food systems will need if they are to meet the changing demand of their consumers.

Figure 1. Africa's Growing Urban Population

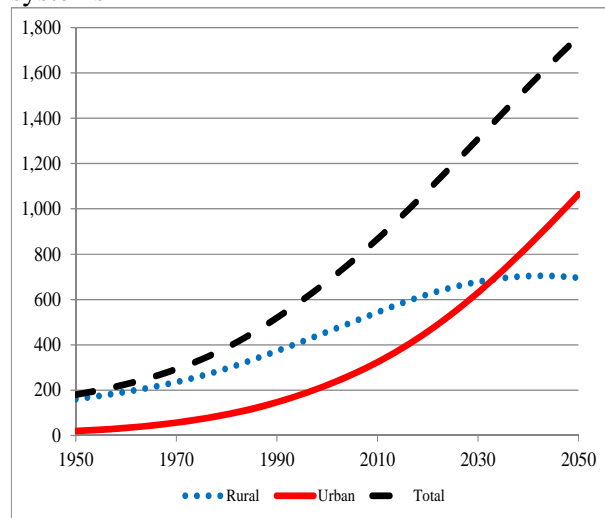
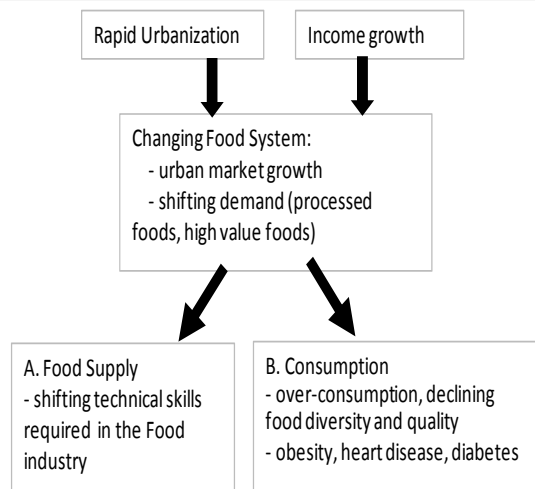


Figure 2. Changes in African Food systems



Source: UN Urban Projections (<http://esa.un.org/unup/>)

3.1. Changing consumption patterns:

We use data from Tanzania (Table 1) and Mozambique (Table 2) to illustrate the coming changes in patterns of consumer demand. Forward-looking projections³ of food consumption in Tanzania suggest four broad conclusions. First, prepared foods dominate current food expenditure as well as future growth. High urban expenditure elasticities coupled with rapid urban population growth suggest annual growth of over 5% per year, leading to over a 25%

³ These projections are based on United Nations population projections, expenditure elasticities computed from the 2008 Tanzania LSMS survey and a projected 2% annual increase in per capita incomes.

food market share by 2050. Second, beverages, both alcoholic and non-alcoholic, will grow even faster, at nearly 6% per year. At that rate, together they will attain nearly a 15% share of food expenditures by 2050. In third position, meat, poultry, and dairy products will grow between 3.5% and 5% per year. By 2050, they will account for 15% of food expenditures. Finally, healthy, fresh, high value foods such as fruits, vegetables and fish will grow steadily, though less explosively, at slightly over 3% per year.⁴ Overall, the growth of fresh products (meat, dairy, fresh produce) and processed products (beverages) suggests great growth downstream after the farm in activities such as processing and maintenance of cold chains.

Table 1. Projected Growth in Tanzanian Food Markets, 2010 to 2050

Food	Value Consumed 2010 (\$ billion/year)			Value Consumed 2050 (\$ billion/year)			Increase 2010 to 2050	
	rural	urban	national	rural	urban	national	\$ billions	rate/year
Prepared foods consumed away from home	1.7	4.0	5.7	4.9	41.7	46.6	40.9	5.4%
Alcoholic beverages	0.8	0.5	1.3	2.3	10.1	12.4	11.1	5.8%
Non-alcoholic beverage	0.5	1.2	1.7	2.0	14.5	16.5	14.8	5.9%
Eggs	0.2	0.2	0.3	0.3	2.0	2.4	2.1	5.1%
Beef	0.8	0.9	1.8	2.6	8.0	10.6	8.8	4.6%
Meat, other than poultry and beef	0.7	0.2	0.9	3.2	2.0	5.2	4.2	4.4%
Poultry	0.9	0.3	1.2	2.7	3.2	5.9	4.7	4.0%
Wheat products	0.8	0.7	1.5	3.2	3.7	6.8	5.4	3.9%
Plantains	1.4	0.2	1.6	5.5	1.0	6.5	4.9	3.5%
Fruits	0.7	0.4	1.1	1.9	2.5	4.4	3.3	3.5%
Milk and dairy products	0.8	0.3	1.2	2.1	2.5	4.6	3.4	3.5%
Rice	2.1	1.4	3.5	6.2	6.6	12.8	9.3	3.3%
Oilcrops and vegetable oils	0.7	0.5	1.2	1.6	2.6	4.2	3.1	3.3%
Fish	1.3	0.7	2.0	3.2	4.0	7.2	5.1	3.2%
Sugar and sweets	1.0	0.7	1.7	2.6	3.1	5.8	4.1	3.2%
Vegetables	1.6	1.0	2.6	2.8	5.8	8.6	6.0	3.1%
Yams, potatoes, other roots and tubers	1.0	0.3	1.3	2.0	1.7	3.7	2.4	2.7%
Other foods (spices, tree nuts, etc.)	0.7	0.4	1.1	1.6	1.5	3.0	1.9	2.5%
Pulses	1.9	0.5	2.4	3.7	2.3	6.0	3.6	2.3%
Sorghum and millet	0.5	0.1	0.7	1.0	0.6	1.7	1.0	2.3%
Maize and maize products	4.6	1.2	5.8	6.9	3.8	10.6	4.8	1.5%
Cassava	1.0	0.2	1.2	1.2	0.5	1.7	0.5	0.9%
Total	25.6	16.1	41.7	63.5	123.6	187.1	145.4	3.8%

Source: Haggblade and Msuya (2011).

The Tanzanian data is typical of LSMS data sets in specifying relatively few (80-100) food items. This limits the insights one can gain and especially runs the risk of not capturing items whose current budget shares are extremely small but which may grow greatly over time. Mozambique, with a vastly larger set of items (over 600) allows us to classify products by processing level (Table 2). We consider food from own production (almost entirely unprocessed) and five types of purchased food: unprocessed, informally processed (typically with low levels of value-added), and three levels of progressively greater formal (or industrial) processing. Arc elasticities are based on the change in budget shares from the bottom to the top expenditure quintile. Results show that formally processed food has substantially larger elasticities than unprocessed and informally processed food, and that the highest level of processing has by far the largest elasticity. These results reinforce the notion that processing is going to take-up a progressively larger share of the food budget among African consumers as time goes on.

⁴ Sensitivity analysis leaves relative growth rankings remain largely unchanged.

Table 2. Arc income elasticities for foods in Mozambique, by processing level

Food Group	Arc Income Elasticity		
	National	Rural	Urban
Own Production	0.98	0.97	0.98
Unprocessed	0.96	1.15	0.88
Informal Processing	0.72	0.91	0.49
Formal Processing Level 1	1.70	1.81	1.46
Formal Processing Level 2	1.17	1.43	1.05
Formal Processing Level 3	2.04	2.03	1.92

Source: Author's calculations from Mozambique IAF data, 2009

3.2. Related changes in food system structure:

Simulation exercises show that value-added at the farm level will increase by a factor of about three over the next 40 years, while value-added downstream after the farm will grow by a factor of six. This dramatic growth in the downstream segment of the food system will be driven primarily by private sector firms. It will also drive a shift in the “center of gravity” in the food system, from people working primarily on production issues (plant breeding, agronomy, extension agents) in public-sector institutions to people working on post-farm issues (storage, processing, food chemistry, food safety, transport, regulatory issues) in private firms (Figure 3). This “double pivot” – from public- to private and from farm- to post-farm – has major implications for the types of skills and attitudes that African AET institutions need to build over the next 40 years.

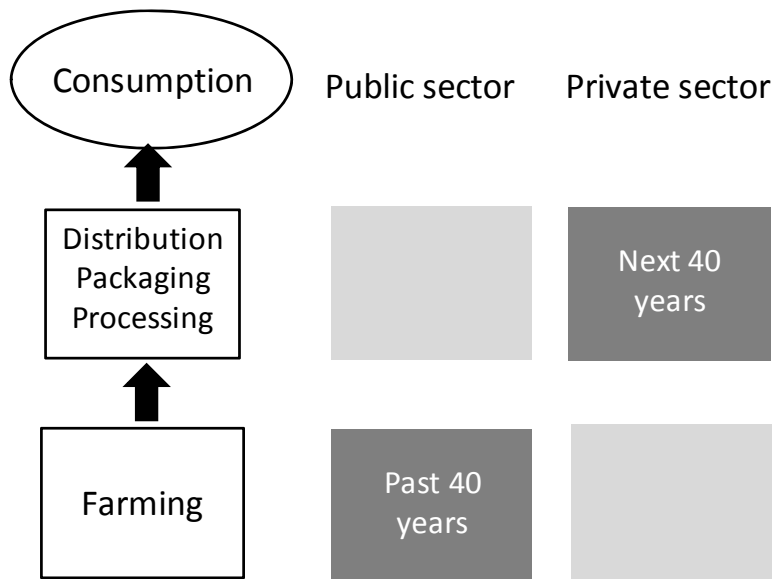
Changes will also occur in the structure of marketing channels. While the so-called “supermarket revolution” has been far less evident in African than elsewhere in the world, these and other “modern” outlets are sure to grow their currently very low market shares substantially over the next 40 years. This growth will eventually have important implications for farmers and consumers.

3.3. Spatial dimensions of changes in consumption:

Staple consumption patterns vary across the continent depending in part on agro-ecological conditions and related cropping patterns, influenced also by history.⁵ For example, the share of maize in total food consumption ranges from 3% to only 6% in West and Central Africa, but from 11% to 21% in East and Southern Africa. Cassava's share ranges from 21% to 44% in West, Central, and East Africa but is only 6% in Africa and 3% in the Sahel. Yam consumption shares are well over 10% in Coastal West Africa, Nigeria, and the Horn of Africa, but nowhere else on the continent do they exceed 1%. We have systematized these differences to define 10 “Food Staple Zones” across the continent (Figure 4). These sharp differences in staple consumption patterns suggest that the trajectory of changes in consumption patterns may also differ across zones. Understanding what these differences might be and what they might imply for the types of skills that are needed is one important element in any forward-looking exercise.

⁵ For example, while much of southern Africa receives too little rainfall to be optimal for maize, it is a dominant staple due to historical factors related to its introduction during the colonial era.

Figure 3. Shifting focus of employment and needed skills in African food systems



3.4. Forecasting changes over the next 40 years:

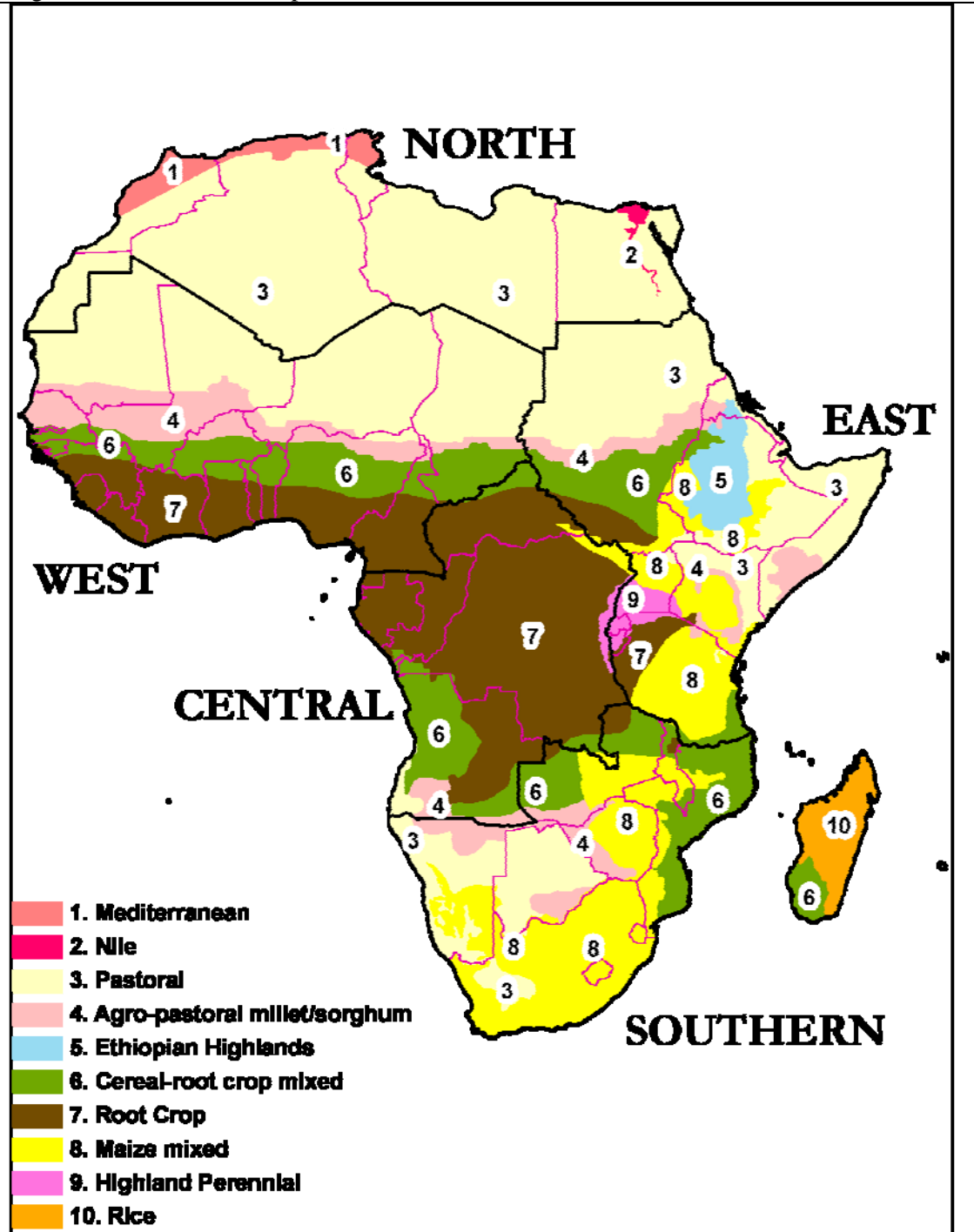
Over the next six months the MAFS consortium (see section 5) will undertake a formal exercise across Food Staple Zones of Africa focused on these issues. The exercise will proceed in two steps. First, we will develop a spreadsheet model to forecast changes in (a) consumption patterns at consumer level and (b) the distribution channels that will carry this food. We will then assess the likely mix of land expansion and yield growth needed to meet these new (and higher) consumption patterns and critically assess what will be needed to achieve the needed increase in volumes and diversity of production.

The forecasting model will project consumption patterns in 10-year increments out to 40 years. Food budget shares will be classified in various ways - by food group, by level of processing, and by marketing channel (“modern” vs. “traditional” sector). Models will be built for different Food Staple Zones to capture the differing starting points reported above. The model will use scenario analysis, varying assumptions on the rate of income growth and on the distribution of that growth. Income distribution will have major impacts on the structure of the food system over time, with more equal growth generating more total growth in demand for food, more rural income growth (thus potentially greater transformation in rural areas), and less poverty.

Data for the exercise will come from several sources. We will use existing forecasts of growth in urban and rural populations from the United Nations. Income elasticities of demand will be developed in an eclectic manner. We will use already-available analysis such as the United States Department of Agriculture estimates of elasticities for seven food groups across 144 countries. Additionally, we will use LSMS data from a range of countries to estimate elasticities. Data sets currently available for this work are in Mozambique, Tanzania, and Uganda, which have nationally representative data for rural & urban areas,

Zambia and Kenya which have detailed urban data sets, and KwaZulu-Natal of South African which has KIDS data for rural & small towns (urban) areas. We will also need to use judgment because, for example, most data sets do not support direct estimates of elasticities by processing level, nor by the detailed food groups we will want to investigate. Finally, we'll use sensitivity analysis to test the robustness of our results to assumptions.

Figure 4. African Food Staple Zones



Source: Adapted from FAO (2000). www.fao.org/docrep/x8200e/x8200e05.htm

4. IMPLICATIONS FOR HUMAN HEALTH, NUTRITION AND PRODUCTIVITY

Coming changes in Africa's food system will not only affect the technical skills required to supply food to the continent's growing urban markets but also human health and nutrition (Figure 2). The nutrition transition traced out by the developed countries and by more urbanized, affluent developing economies in Asia and Latin America suggest that Africa will encounter serious nutritional hazards over the coming decades. As an increasingly urbanized population begins to rely on marketed and processed foods, as they transition to a more sedentary lifestyle and as they lose access to many nutritious indigenous foods, new health problems typically emerge.

The nutrition transition in successful developing countries involves a surprisingly rapid shift from large-scale energy deficits to widespread over-consumption, with diets that are too high in energy from fat and processed sugars (Figure 7a, default trajectory). Today, while one billion people suffer from hunger, another billion are overweight, including 23% of all Chinese, 40% of South African adults and 70% of Mexicans (Pinstrup-Andersen and Watson 2012). Resulting problems of obesity, heart disease and diabetes impose heavy costs on human health, worker productivity and public health systems.

In addition, urban consumers lose access to many nutritious indigenous foods they formerly consumed in rural areas -- wild fruits and vegetables, a rich variety of greens (pumpkin leaves, cassava leaves, kale, spinach and sweet potato leaves) and indigenous cereals such as teff, fonio, sorghum and millet. The urban shift to prepared, processed foods typically leads to a diet high in saturated fats, sugar and refined foods and correspondingly low in fiber, vitamins and micro-nutrients (Figure 7b, default trajectory). The resulting reduction in dietary intake of vitamins, fiber and minerals leads to micro-nutrient deficiencies, immune system and other metabolic deficiencies and increased susceptibility to disease, including many forms of cancer.

At the same time that under-nutrition remains a serious problem, Africa, like other developing regions, must prepare to confront the rapidly increasing costs of over-nutrition. Currently in China and India, the costs of under-nutrition, including cognitive development and worker productivity, range between 1% and 2% of GDP. The productivity and public health costs of over-nutrition and the nutrition transition are growing very rapidly in both countries, and by 2025 they will exceed the costs of under-nutrition (Popkin 2003). Investments in nutritional research and education, incentives that improve intake of fresh fruits, vegetables and fiber and employer and public incentives that increase levels of physical activity can all contribute to moderating the public health costs of the nutrition transition (Figure 7, preferred trajectory).

5. ANTICIPATING AND ADAPTING TO CHANGE

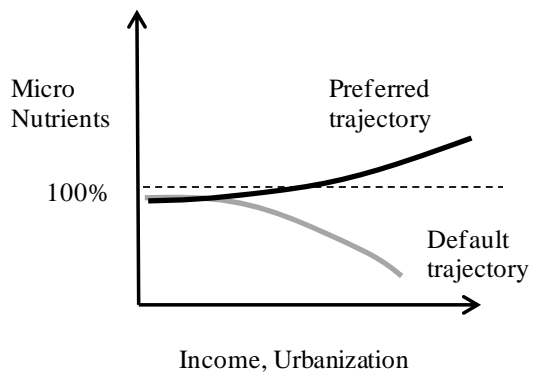
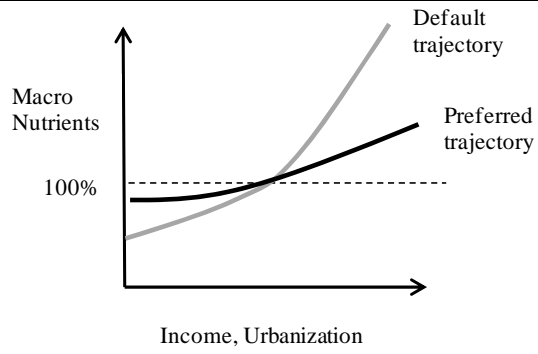
As the world's poorest and most rural continent, Africa can learn from the experiences -- and from the mistakes -- of more rapidly growing first movers in Asia and Latin America about the technical challenges and public health implications of Africa's coming food system transition. Most importantly, Africans can glean insights about concrete steps they can take now to anticipate emerging challenges and to shape the food system transition in ways that will facilitate sustainable agricultural productivity growth, economic development and improve public health. Two complementary efforts have emerged to provide forward-looking, empirically based, public domain analysis that will help to inform and mold this incipient African food system transition.

The first of these efforts, the Modernizing African Food Systems (MAFS) consortium, focuses on the supply side of African food markets to find ways of facilitating the major supply shifts anticipated in Africa's food system. Spearheaded by a consortium of agricultural education and training (AET) institutions, the MAFS team aims to project the likely growth trajectories of African food systems and help private sector food processors and African educational institutions to anticipate and prepare skilled labor demands required for rapidly urbanizing societies (Figure 2A). A MAFS advisory board, chaired by Professor Richard Mkandawire, and representing continental AET institutions, public sector support institutions and private food industries helps to guide the MAFS analytical work and helps to mobilize resources in support of TEAM Africa, ANAFE, RUFORUM, FARA and other institutions seeking to position Africa's AET institutions for the needs of the 21st century (MAFS 2012).

To complement the MAFS efforts on the supply side of Africa's food system, Africa's Bending the Curve Consortium (BCC) focuses on the consumer transition that accompanies food system transformation. Specifically, Africa's BCC aims to undertake strategic action, advocacy and research that will help to bend the curve in Africa's nutrition transition toward the preferred, healthier nutritional trajectory (Figure 5). In doing so, ABCC intends to help anticipate and mold this transition in ways that minimize the public health costs and maximize human productivity gains as African food systems change. The coalition of African AET and agricultural support institutions that has emerged to work with the private sector food industry and public sector support institutions and donors has defined an initial agenda that focuses on the following three start-up activities : a) an executive education seminar for food industry leaders and African policy makers highlighting the lessons learned from other regions about the nutrition transition its costs and potential mitigating actions; b) an interdisciplinary university-level curriculum and training program that will enable African AET institutions to invest now in a generation of African students with awareness and expertise spanning the fields of food technology, human nutrition, consumer and sensory sciences and public health; and c) a business-oriented program of support for food industry entrepreneurship developing and marketing high quality and indigenous foods (BCC 2012).

Both efforts are highly participatory and self-motivated. We, therefore, will welcome participation of other like-minded professionals such as those attending this important RUFORUM forum today.

Figure 5. The Nutrition Transition: Bending the Curve



6. CONCLUSIONS

Whereas this is work in progress, a number of key messages can be derived from the on-going work:

- i) Urbanization will be a key driver of the changes in the African food systems in the next 40 years.
- ii) More food will be required for consumption by the increased urban population and this food will have remarkable differences in characteristics from those that this population consumed in its rural setting before it shifted. This food will be more processed, better packaged, more ready to eat, and must pass certain hygienic and safety standards
- iii) The new food characteristics in (ii) above will require three responses—the African AET institutions will need to reshape their curricula to provide skills that match the new food consumption characteristics; the same AET must strengthen and acquire new models of engaging with the private sector because their role in this transformation will be more than ever before; the increased food consumption in the urban areas is likely to be associated with widespread of consumption with diets too high in energy and fat and processed sugar leading to obesity, heart disease and diabetes. At the same time, due to changes in the biochemistry of these foods due to processing, vitamins, minerals and micronutrients are likely to be missing leading to serious nutrition and public health concerns. All these will require private and public sector intervention in key education, action research and knowledge dissemination areas. MAFS and ABCC intend to orchestrate these interventions.

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