Food systems and the escape from poverty and ill-health traps in sub-Saharan Africa

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Abstract: Millienium Development Goal #1 is to halve extreme poverty ($1/day per person) and hunger. Progress toward this goal has been excellent at global level, led by China and India, but woefully insufficient in sub-Saharan Africa. In Africa, a disproportionate share of the extreme poor are "ultra-poor", surviving on less than $0.50/day per person, a condition that appears both stubbornly persistent and closely associated with widespread severe malnutrition – "ultra hunger" – and ill health. Indeed, ill health, malnutrition and ultra-poverty are mutually reinforcing states that add to the challenge of addressing any one of them on its own and make integrated strategies essential. Food systems are a natural locus for such a strategy because agriculture is the primary employment sector for the ultra-poor and because food consumes a very large share of the expenditures of the ultra-poor. The causal mechanisms underpinning the poverty trap in which ultra-poor, unhealthy and undernourished rural Africans too often find themselves remain only partially understood, but is clearly rooted in the food system that guides their production, exchange, consumption and investment behaviors. Four key principles to guide interventions in improving food systems emerge clearly. But there remains only limited empirical evidence to guide detailed design and implementation of strategies to develop African food systems so as to break the lock of poverty and ill-health traps.

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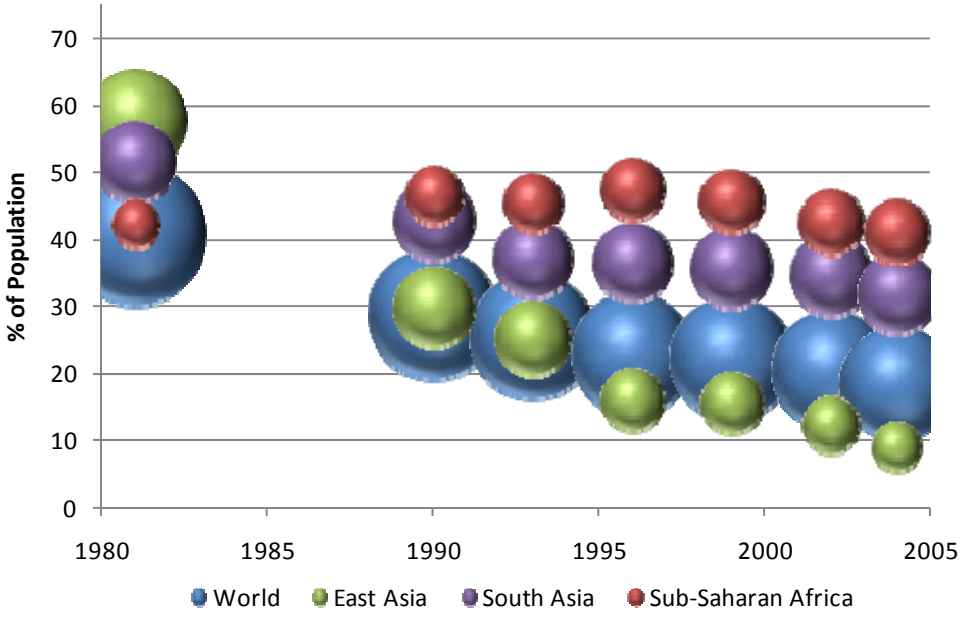
Introduction

The Millenium Declaration of September 2000, adopted by the 189 member states of the United Nations, renewed the vigor of the global community's commitment to improve living conditions throughout the world. The very first Millenium Development Goal (MDG) is to halve, by 2015, the proportion of people living in extreme poverty and suffer from hunger. This paper focuses on that objective and its relation to food systems– the human-managed biophysical systems that are involved in the production, distribution and consumption of food – especially in sub-Saharan Africa (SSA).

Figure 1: Extreme Poverty, 1981-2004



Bubble sizes reflect number of people living in extreme poverty ($1.08/day-person)
Data source: World Bank, *World Development Indicators*

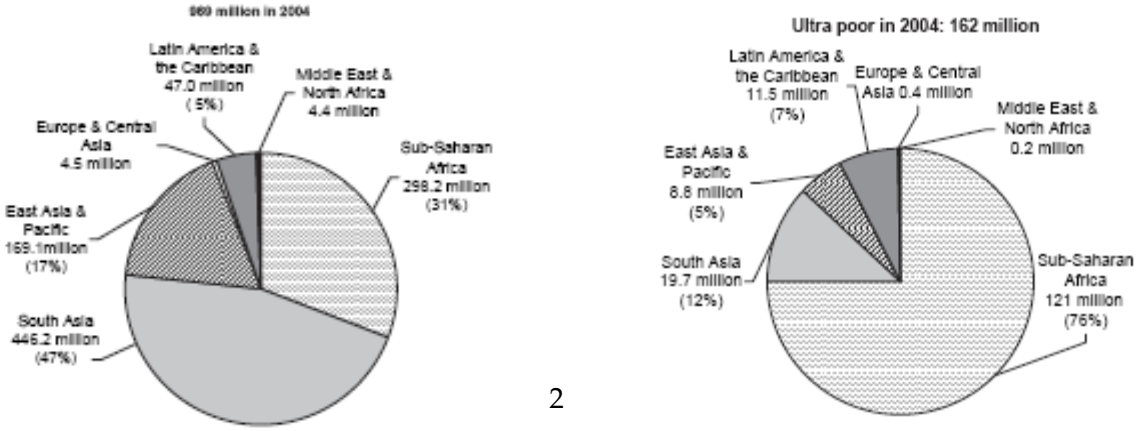
The bold but attainable goal enshrined in MDG#1 seems likely to be met at global scale. As shown in Figure 1, the share of the population living under the global extreme poverty line has fallen by more than half since 1981, led by dramatic improvements in India and, especially, China. Indeed, at current trends, the World Bank projects that the number of people living in extreme poverty will be halved by 2015 relative to 1981, from 1.4 billion to only 700 million, a remarkable accomplishment given steady population growth. This still leaves an unacceptably

large number of people in extreme poverty. Moreover, in key parts of the world, notably SSA, progress has been virtually non-existent. But while there remains serious work to be done, especially in SSA, the experience of the past quarter century should remind us of the remarkable progress that is possible. There is reason for hope.

Poverty and hunger go together in MDG#1 because extreme income poverty goes hand-in-hand with poor nutritional status, with mutually reinforcing causation. This close relationship between poverty and malnutrition is reflected in hunger or micronutrient undernutrition statistics that show no significant progress in SSA in the past twenty years, just as we have seen negligible progress in reducing income poverty there. Thus the likelihood of meeting the first MDG in SSA is discouragingly low.

Of perhaps greatest concern, recent research finds that the ultra-poor – those living on less than half the global extreme poverty line, i.e., $0.54/day per capita – are disproportionately concentrated in SSA (Ahmed et al. 2007). While SSA was home to only 31% of those living below the dollar a day poverty line worldwide in 2004, 76% of the world's ultra-poor lived in SSA (Figure 2). Furthermore, progress among the ultra-poor has been far slower than among the extreme poor. There were 29 million more Africans living in ultra-poverty in 2004 than in 1990. While extreme poverty is an overwhelmingly Asian phenomenon, ultra-poverty is primarily an African condition. This may well help account for the relatively poor performance of SSA in achieving poverty reduction overall. It is the only region where a plurality of the poor in 1990 were ultra-poor. Poverty reduction is easier where the poor are nearer the poverty line, as was especially true in Asia and Latin America, relative to SSA.

Figure 2: Extreme (<$1/day per capita) and Ultra (<$0.50/day per capita) poverty, 2004



Similarly, ultra-hunger, defined as consumption of less than 1600 calories/day per capita, is alarmingly high in SSA, far moreso than in any other region of the world. Thus the deepest poverty and the most severe hunger is proving the most intractable. Poor nutrition combines with high prevalence of infectious disease (HIV/AIDS, malaria, tuberculosis, etc.) to create widespread ill-health that reinforces ultra-poverty in a way that poses serious humanitarian and development challenges for SSA.

Growing recognition of the unsettling multidimensional challenge of ultra-poverty and ill-health has rekindled long-dormant interest in poverty traps. The idea is an old one, reflected in prominent development theories of the 1940s and 1950s that tried to explain the geographic clustering of poverty in the world (Rosenstein-Rodan 1943, Nurkse 1953, Myrdal 1957, Hirschman 1958). The essence of a poverty trap is that there exists a low-level equilibrium level of well-being in which individuals, households, communities, nations or even multinational regions appear caught unnecessarily. Small adjustments are insufficient to move people, communities or nations out of those equilibria sustainably. Systems must change, major positive shocks must occur, or both. And in the absence of systemic change, recurring adverse shocks will only drive more people into the trap. The sorts of health shocks that remain distressingly commonplace in SSA can, along with population growth, help explain the growth of ultra-poverty in the region. This paper therefore focuses on the basic nature of the apparent ultra-poverty/ultra-hunger/ill-health trap in SSA, the importance of risk, and the need for systemic change, starting with food systems.

The Poverty/Ill-Health Trap

The basic idea is that a poverty trap is "any self-reinforcing mechanism which causes poverty to persist" (Azariadis and Stachurski 2004, p. 33). This can include single equilibrium systems where the unique equilibrium is at a low-level of well-being or systems characterized by multiple dynamic equilibria, at least one of which involves an unacceptably low standard of living. The poverty traps idea remains a conjecture – albeit a compelling one – because finding irrefutable empirical evidence that there exist poverty traps really exist remains a difficult

challenge for researchers. This difficulty arises due both to paucity of high quality longitudinal data on households and individuals in low-income countries and to disagreements among technical experts over how best to test the hypothesis that some people might be caught in a poverty trap.[1] While it is important to attack that epistemological question via basic research in the social sciences, the core empirical fact of widespread ultra-poverty, ultra-hunger and ill-health that has proved largely intractable to recent interventions remains regardless of the academic dispute. And there is much that we already know that can usefully inform policy even as the intellectual struggle continues to understand more rigorously and precisely the etiology of SSA's apparent poverty trap.

The most basic thing we know is that ill-health, malnutrition and ultra-poverty are mutually reinforcing states. The links are multidirectional. Low real incomes are the primary cause of chronic and acute hunger, as a vast literature spawned by Amartya Sen (1981) emphasizes. Even when food availability is adequate – which is not the case in large portions of SSA today – low incomes impede access to sufficient and appropriate food to maintain a healthy lifestyle. But causality runs the other way as well. The WHO (2002) reports that undernutrition, including micronutrient deficiencies, is the leading risk factor for disease and death worldwide, accounting for over half the disease burden in low-income countries. Undernutrition also impedes cognitive and physical development, thereby depressing educational attainment and adult earnings.

Disease, in turn, impedes the uptake of scarce nutrients, aggravating hunger and micronutrient malnutrition problems and hurting labor productivity and earnings. Indeed, recent research suggests that major health shocks are perhaps the leading cause of collapse into long-term poverty (Gertler and Gruber 2002, Barrett et al. 2006, Krishna 2007). And a large literature amply demonstrates the corollary that improved nutrition and health status increase the current and lifetime productivity of individuals, thereby increasing incomes and assets and contributing to poverty reduction (Dasgupta 1997, Schultz 1997, Strauss and Thomas 1998).

[1] See Azariadis and Stachurski (2004) and Carter and Barrett (2006) for some discussion of the technical issues and empirical disagreements in the literature.

And, of course, poverty depresses demand for health care, hygiene and other inputs into good health, so that poverty is a cause as well as a consequence of ill-health. Furthermore, since much health care provision is a public good funded by tax revenues, areas of concentrated ultra-poverty commonly cannot afford the physical infrastructure or professional staffing necessary to ensure an adequate, high quality supply of preventive and curative health care in very poor communities. This relationship between the public finance problems associated with health care provision and the dynamics that lead to individual- and household-level poverty and ill-health traps is a classic example of spillovers between micro- and meso-scale phenomena that lead to what Barrett and Swallow (2006) term "fractal poverty traps", meaning patterns that are replicated at multiple scales of analysis. The reinforcing feedback among poverty, ill health and hunger – manifest at all levels of analysis in contemporary Africa – is clear and important. This is a central characteristic of the ultra-poverty/ill-health trap apparent in SSA today.

We know two other key things about poverty traps that merit brief review. First, initial conditions matter. This applies not just to nutritional and health status (e.g., low birth weight babies typically have retarded cognitive and physical development, with long-term economic and health consequences), but far more broadly. Those who possess the means to invest are commonly better able and more willing to secure credit, access to complementary resources, political favors or whatever else it might take to induce investment, whether in new production technologies, new marketing relationships, education and health care for children, productive new assets, or improvements to the natural resource base on which future earnings depend. And such investment is the engine for exiting long-term poverty and hunger.

In thinking about initial conditions for the ultra-poor in SSA, it is extremely important to keep in mind that they are especially likely to live in rural areas. Poverty remains a disproportionately rural phenomenon worldwide. But this is especially pronounced among the ultra-poor; the average percent difference between rural and urban poverty incidences roughly 400 percent for the ultra-poor, more than twice as large a gap as for those living on $0.51-1.00/day per person (Ahmed et al. 2007). Rural peoples depend heavily on the natural resource base for their livelihoods, as farmers, fishers, forest product gatherers, herders and workers.

And in much of SSA, soil fertility and water access are especially poor, and in many places, deteriorating. Furthermore, the physical and institutional infrastructure to support commerce, innovation and value-addition are commonly rudimentary or absent. For example, in 1999 (the most recent year for which comparable data are available), only 12.1% of the roads in SSA were paved, as compared with 36.3% worldwide and even 30.8% in south Asia (World Bank 2007a). These areas have been disfavored by both nature and states, creating an immediate disadvantage for rural Africans' productivity and investment incentives.

The second key thing we know about poverty traps is the importance of risk. Even transitory shocks can have persistent effects by casting people onto a downward spiral into destitution from which they do not recover, or by keeping them from growing their way out of persistent poverty by regularly knocking them backwards as they struggle to climb out of the trap, a real-world Sisyphean tragedy (Dercon 1998; McPeak and Barrett 2001; Dercon 2005; Carter and Barrett 2006; Santos and Barrett 2006; Carter et al. 2007, Krishna 2007).

People's response to shocks – both ex post and ex ante – can likewise trap them in poverty. Risk can have two distinct, crucial effects in systems characterized by poverty traps. First, *ex ante* efforts to reduce risk exposure can dampen accumulation – either voluntarily or through credit rationing – thereby creating a low-level equilibrium. Second, the *ex post* consequences of a shock—both the shock's direct biophysical effects or those due to coping strategies taken in response to the shock—can knock vulnerable people back into a poverty trap.

The ultra-poor who disproportionately inhabit rural SSA are especially risk-exposed. Conflict and associated complex emergencies are perhaps the most shocking source of risk borne by rural Africans. But even where peace reigns, weather-related risks disproportionately affect rural peoples and the agriculture sector through drought and flooding, the effects of which are compounded by less reliable physical and institutional infrastructure for responding to shocks. These patterns are aggravated by spatial inequality in the coverage and effectiveness of public and veterinary health systems, which strongly favor richer areas. Overall, people in low-income countries are four times more likely to die due to natural disaster and cost per disaster as a share of GDP are considerably higher in developing than in OECD countries

(Gaiha and Thapa 2006), and poorer, rural areas appear far more vulnerable to disasters than are wealthier and more urban areas. Moreover, at the household level, evidence from drought in Ethiopia indicates that the medium-term effects of shocks vary by initial wealth, with poorer households feeling the adverse effects more acutely and for a longer period (Carter et al. 2007).

The most serious and commonplace catastrophic risk faced by the African rural poor, however, is ill-health. As already mentioned, health shocks are the single most common explanation people offer for how previously non-poor families collapsed into persistent poverty. Those in or at risk of falling into poverty traps fax a range of health challenges: maintaining an adequate diet, avoiding injuries most commonly associated with manual labor that is the mainstay of the poor, and staving off diseases commonly associated with unreliable water supplies, exposure to animal and human waste, and other standard hardships of poor communities. Furthermore, the ultra-poor are concentrated in an employment sector that is especially risky. The International Labour Organization (2000) reports that the agricultural sector is the most hazardous to human health worldwide, accounting for a majority of work-related mortality globally due to exposure to animals, chemicals, plants and weather, use of hazardous tools and machinery, long working hours under physically challenging conditions, etc.

The ultra-poverty/ill-health trap that seems to characterize so much of rural SSA today is thus intimately caught up with (i) the interrelationship between hunger, ill-health and low productivity, manifest in low incomes, (ii) poor initial conditions associated with health and nutrition, especially early in childhood, but also with the state of infrastructure and the natural resource base on which rural livelihood disproportionately depend, and (iii) risk exposure, which is especially severe in rural areas and in agriculture. So what bridges these central characteristics and thus where should one focus in responding to the imperative for action to address widespread ultra-poverty, ultra-hunger and ill-health? The closely coupled nature of ill-health, hunger and poverty problems add substantially to the challenge of addressing any one of them on its own and thereby make integrated strategies essential. Food systems are the

natural locus for developing an integrated strategy for addressing hunger, ill-health and poverty jointly.

Food systems improvements as the core of a sensible strategy

As several recent studies make clear, agriculture is the lead sector for reduction of poverty and hunger, especially in sub-Saharan Africa (Christiaensen and Demery 2007, Diao et al. 2007; World Bank 2007b). Real GDP growth from agriculture is 2.7 times more effective in reducing the extreme poverty headcount in the poorest quarter of countries, including most of SSA, than is growth in non-agricultural sectors (Christiaensen and Demery 2007). And the focus must fall squarely on stimulating a smallholder food productivity revolution.

The reasons are straightforward. First, agriculture is the primary employment sector for the poor. A super-majority of Africa's ultra-poor are small farmers who grow food, at least part time. Since earnings are determined by the productivity of one's asset holdings and the labor is the primary asset of the poor, their earnings in food agriculture are fundamental to their well-being. Rural Africans are disproportionately ultra-poor because their labor productivity is so low. Boosting the productivity of the labor, land, livestock and other assets controlled by the poor must be at the center of any strategy for breaking out of the ultra-poverty/hunger trap.

Second, although most of the ultra-poor are employed in agriculture, their productivity is so low that they typically do not produce enough to feed their families, forcing them to depend on non-farm earnings to supplement farming to pay for their net purchases of food. As Barrett (forthcoming) documents, across a wide array of staple grain commodities, countries and years, multiple data sets consistently indicate that a small minority of food crop producers are net (or even gross) sellers of these commodities (Table 1); and within that minority, sales are heavily concentrated among just a few of the larger farmers. Because most smallholders are actually net buyers of the basic foods they produce, productivity gains not only have favorable real output effects on their well-being, but any induced declines in real food prices caused by aggregate supply expansion also benefit them.

Table 1: Staple Foodgrains Market Participation in Eastern and Southern Africa

Country	Crop	Year	% Sellers (g=gross, n=net)
Ethiopia	Maize and teff	1996	25 n
	Barley	1999-	10 g
	Maize	2000	23 g
	Sorghum		11 g
	Teff		20 g
	Wheat		12 g
Kenya	Maize	1997	29 n
		1998	34 n
		1999	39 n
		2000	30 n
Madagascar	Rice	1990	32 g
		2001	25 n
Mozambique	Basic food	1996-7	14 g
	Maize	2001-2	30 g
	Maize	2005	16 g
	Rice	2002	43 n
Rwanda	Beans	1986-7	22 n
	Sorghum		24 n
Somalia	Maize	1986-7	39 n
Tanzania	Food	2003	33 n
Zambia	Maize	2000	26 n
Zimbabwe	Maize	1984-5	45 n
	Grains	1996	27 g

Reproduced from Barrett (forthcoming).

Meanwhile, food is overwhelmingly the largest share of the budgets of the ultra-poor – whether or not they farm – routinely 65-80 percent of total household expenditures in this subpopulation (Ahmed et al. 2007). Since the budget share reflects the instantaneous elasticity of welfare with respect to prices, this fact signals that supply expansion that reduces real food prices is to be welcomed as it has a dramatic effect on the ultra-poor.[2] This point is, of course,

[2] At the time of writing, Africa and the rest of the world face rapid food price increases due primarily to strong growth in demand for food both for improving diets in rapidly growing Asian economies and for biofuels production in high-income countries. The humanitarian concerns associated with these price rises reflect precisely the net buyer characteristic of the overwhelming majority of the poor, although

consistent with the longstanding observation that the bulk of the poverty reduction benefits of the Green Revolution in Asia (and to a lesser extent, in Latin America) came about through increased consumer surplus accruing to poor food buyers, not from income gains to farmers.

The ultra-poor's sectoral affiliation as agricultural producers and workers, and the heavy concentration of their expenditures on foods both point toward food systems as the nexus where interventions are most likely to bear substantial fruit. These effects are reinforced by the strong (backward and forward) linkages from agriculture to secondary and tertiary sectors in the economy.

Minten and Barrett (2008) provide strong empirical evidence that better agricultural performance – as proxied by higher rice yields in their analysis of Madagascar – is strongly correlated with higher real wages, improved rice profitability and lower real consumer prices for the staple food. A doubling of rice yields in this setting leads to an average reduction 38 percent reduction in the share of food insecure households in the community, shortens the average hunger period by 1.7 months (or one-third), and increases real unskilled wages in the lean (planting and growing) season by 89 percent due both to lower real rice prices and to increased demand for unskilled labor by wealthier farmers. Thus greater food crop productivity reduces extreme poverty for all the major subpopulations of the poor – net rice buyers, net rice sellers and unskilled workers – with the gains accruing disproportionately to the poorest: workers and poor net food buyers.

Such findings are not surprising since improvements in food systems have been the foundation of poverty reduction and modern economic growth throughout history. All past cases of rapid, widespread progress from poverty have been causally associated with the transformation of food systems, from 18th and 19th century Europe and North America to late 20th century east Asia. Striking increases in agricultural productivity, improvements in food safety, and markedly reduced costs of food distribution improved the quantity, quality and

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many observers continue to overlook the fact that this includes most small farmers. The fact that current price rises are due to demand growth far outpacing supply expansion underscores the central point that accelerating productivity growth in food agriculture is critical to the well-being of the poor.

variety of food available at lower prices. These food system advances permitted historically unprecedented growth in incomes, life expectancy and population, decreased the risk of chronic or acute malnutrition and enabled increased investment in education and non-agricultural activities in today's advanced economies (Fogel 1994, Johnson 1997, Maddison 2001, Fogel 2004). In Asia, rapid increases in crop yields have been major drivers of historically unprecedented declines in poverty. By contrast, in SSA, staple grain yields have remained stagnant at roughly one ton/hectare for the past twenty-something years; and headcount poverty measures have remained similarly stuck at 40-50% of the population.

The "food problem" was Schultz's (1953) label for the observation that until communities and countries made scientific and institutional advances to reliably meet their subsistence food needs through improved production, processing and trade, few could begin the process of modern economic growth. This view has been largely echoed in a vast subsequent social science literature (e.g., Boserup 1965, Geertz 1966, Diamond 1997, Timmer 2002, Gollin et al. 2007). Growth in agricultural productivity directly accounts for a disproportionately large share of economic growth and poverty reduction in a range of rapidly growing developing countries over the past several decades (Ravallion and Datt 1996, Gollin et al. 2002). Much of this effect arises from agricultural linkages to non-agricultural sectors, including to human nutrition and to improved natural resources management.

Are food systems the only thing that matter? Absolutely not. But they are hugely important and have been seriously underemphasized over the past decade or two as international assistance for agriculture has lagged, and rural institutions and public goods and services have been dismantled. Complementary efforts in health systems, in information systems, in peacemaking and other areas are also important. But ultimately, it is very difficult to envision, based on the historical or current empirical evidence, any substantial progress in freeing SSA from its apparent ultra-poverty/hunger/ill-health trap without significant advances in the continent's food systems.

Key principles for targeting within SSA food systems

So where are the entry points within food systems for helping unlock the ultra-poverty/hunger/ill-health trap in which so much of rural SSA finds itself? Food productivity gains are, as one would expect, strongly and positively associated with the adoption of improved agricultural production technologies, the stock of productive assets (soil quality, livestock, etc.) under farmers' control, access to supporting services (such as agricultural extension), the availability of irrigation and market access.[3] The latter four variables have both direct and indirect effects – through induced technology adoption – on crop yields in rural SSA. These are perhaps the most potent policy levers available if one wants to improve agricultural productivity so as to reduce poverty and food insecurity.

But a key is to guard against excessive generalization. The binding constraints to progress vary from country to country and often from place to place within individual countries. There is no substitute for careful contextualization and empirical validation of specific policy ideas. There are, however, several key principles that can be clearly identified from a growing mass of evidence. I list these in order of importance.

Principle 1: Build and protect household-level productive asset endowments.

Given production technologies and the market and non-market institutions that value what a household produces, earnings depend directly on the stock of productive assets to which a household has access. This includes both privately owned assets such as human capital, land, livestock or financial savings, as well as common property or public goods such as road or irrigation infrastructure. The most basic pathway out of poverty is to accumulate productive assets. In a poverty trap, however, investment is low because the incentives to invest are poor and thus meager asset holdings emerge as a low-level equilibrium.[4] Changing this condition is a first-order imperative.

[3] See, for example, Minten and Barrett (2008) for empirical evidence on these points.

[4] Migratory pastoralism offers a clear example and strong recent evidence of poverty traps wherein herd sizes below a threshold level induce herd loss (due to involuntary sedentarization) while herd sizes above that threshold tend to lead to herd growth by taking advantage of spatiotemporal variation in water and forage availability. Lybbert et al. (2004) and Barrett et al. (2006) offer detailed evidence from Ethiopia and Kenya, respectively.

In some cases, assets must be provided to poor people who are simply unable to reserve any of their negligible income for investment. Examples include feeding programs for destitute sub-populations facing emergencies, free education for children, etc. But in most settings, the key is to change investment incentives. In some cases, this requires firming up the institutions that ensure secure access to private property – rules of resource tenure, police protection against property crime, etc. Often, it requires investment in complementary inputs – so-called "crowding in" investment, whether in key infrastructure (e.g., roads, electrification, water) or in human capital through education and health programming, perhaps especially for pregnant women and children three years of age and younger. In other cases, this requires resolving financial markets failures – both in credit and insurance – so as to enable people to borrow against future expected earnings and to shield their investment from transitory shocks that might otherwise imperil them. Indeed, an oft-overlooked element of changing incentives for asset accumulation concerns the provision of safety nets. Informal social arrangements commonly provide some measure of insurance against shocks for those who are reasonably well-integrated into local social networks (Vanderpuye-Orgle and Barrett forthcoming). But many people appear to fall through the holes in social safety nets in rural Africa. Moreover, these necessary cannot handle major, covariate shocks that simultaneously challenge most or all members of a social network. Hence the role for public (or external, private) provision of safety nets in the form of employment guarantee schemes, post-drought herd restocking, emergency (food and cash) assistance programs, etc. Indeed, recent theoretical work suggests that productive safety nets may be the highest return policy instruments available in economies characterized by poverty traps (Barrett, Carter and Ikegami 2007).

One asset of special concern in rural SSA today is soil fertility. The land is the main non-human asset to which the poor have access. And it is degrading rapidly in much of SSA, contributing mightily to the apparent poverty trap in which many rural Africans presently find themselves. Recent estimates show that Sub-Saharan Africa faces what a recent study refers to as "an escalating soil fertility crisis" (Morris et al. 2007, p. 18); the region lost 4.4 million tons of nitrogen, 0.5 million tons of phosphorous, and 3 million tons of potassium between 1980 and

2004, costing the continent more than $4 billion worth of soil nutrients per year (IFDC 2006). Declining soil fertility is also aggravating the problem of parasitic weeds in the S*triga spp.*, which cause more than $7 billion in yield losses and affect more than 100 million farmers annually in sub-Saharan Africa (CIMMYT, 2007). Shrinking landholdings due to subdivision, continuous cropping, insecure land tenure and unaffordable fertilizer have resulted in severe soil degradation, diminished crop productivity and incomes, malnutrition and vulnerability to ill health. Without effective interventions to increase soil productivity and cropping system diversity, many farmers and their families are unable to produce enough food to feed their families or to earn adequate incomes. They then resort to the destructive, but perfectly rational, exploitation of the surrounding natural resource base, such as cutting down trees to make charcoal or clearing the river and stream banks' protective vegetation to grow vegetables. While the importance of soil nutrient depletion to poverty reduction and overall economic development in Sub-Saharan Africa was emphasized by the June 2006 international fertilizer summit in Abuja, Nigeria, attended by many African heads of state and governments (IFDC 2006), systems level understanding of this growing crisis and of appropriate interventions remains distressingly scarce. In this setting, poverty reduction depends on improving our understanding of the economic, social and biological aspects of food systems as a precursor for identifying sustainable and adoptable solutions that will enable and encourage SSA farmers to build and protect their stock of natural capital in the soil.

Principle 2: Improve the productivity of the poor's current asset holdings.

Increasing the returns to the assets held by the poor is the second core principle that must underpin strategies to improve African food systems. This happens both through technological improvements to the physical productivity of food production and post-harvest processing systems, and through advances in marketing systems that squeeze out costs from distribution channels and improve the economic returns farmers enjoy per unit of output grown while simultaneously holding down food prices for net buyers.

It is important to recognize that this is the second principle because adoption of improved technologies and participation in more remunerative marketing channels commonly depend in large measure on households' asset endowments. The consistently strong positive relationship one finds in the literature between land holdings, livestock ownership, credit access or other measures of wealth and either adoption of improved technologies or natural resources management practices or participation in higher-value-added markets underscores how important asset endowment effects are to understanding patterns of productivity growth in food systems. Ultra-poor farmers commonly lack the assets to produce marketable surpluses and therefore cannot afford new technologies nor reap the considerable gains attainable from market-based exchange, which limits their ability to accumulate (or borrow) assets, reinforcing the initial condition and generating a low-level dynamic equilibrium (Carter and Barrett 2006). Making improved markets and technologies available is very important, but limited uptake is to be expected in the absence of adequate endowments to take good advantage of these new opportunities.

The returns to research on improved agricultural technologies have always been and remain high. The World Bank (2007b) estimates the average rate of return on agricultural research in SSA at roughly 35% per annum, far higher than returns on financial assets in virtually all SSA countries. Yet agricultural research remains severely underfunded on the continent. Although 75% of the extremely poor live in rural areas and are (at least partly) employed in agriculture, only 4% of global overseas development assistance (ODA) goes to agriculture (down from 10% in 1990) and only 4% of public expenditures in SSA are directed to agriculture (World Bank 2007b). And those figures heavily overstate the resources devoted to agricultural research and institutional development because they include the administrative costs of Ministries of Agriculture, which account for the overwhelming majority of such funds. Without a substantial reallocation of ODA and public resources in the direction of agricultural research, productivity growth in African food systems and thus progress in the fight against poverty, ill health and hunger will be slow at best.

Meanwhile, the productivity problems of ultra-poor smallholders are magnified by relatively poor integration into national and global markets and by rapid changes overtaking agrifood supply chains in the low-income world. Rapid concentration worldwide in both upstream input (e.g., seed, fertilizer) and downstream food wholesale and retail industries threatens the future of small farms worldwide (Reardon et al, 2003). We know remarkably little about who is able to participate in modern agrifood marketing channels, under what terms, and with what effects. Nor do we know much about what interventions – e.g., in supporting the creation or expansion of farmer cooperatives, provision of infrastructure, improved monitoring and enforcement of grades and standards and of contracts, etc. – favorably affect poor rural residents' capacity to take advantage of these changes, whether as suppliers, consumers or workers. These are key research areas because improving the incidence and terms of market participation by the rural poor is such an important principle for food systems interventions.

Principle 3: Improve risk management options for the ultra-poor.

Risk is a key impediment to investment in building up stocks of productive assets and to uptake of new technologies or participation in emerging marketing channels. Thus it is closely related to the preceding two principles. But this is where an added, tragic dimension enters: even if an ultra-poor household does make all the sacrifices necessary to invest in building up productive assets, to adopt all the best technologies and to participate in the most remunerative marketing channels, it can all be wiped away in an instant. Catastrophic shocks – due to drought, flooding, disease, injury, conflict, crime, price fluctuations, etc. – are distressingly common, and relatively little of this risk exposure is insured, formally or informally. Thus improving risk management is central to the task of breaking rural SSA out of the ultra-poverty/hunger trap.

There are three big challenges in improving risk management. The first is the multidimensionality of the serious risks faced by the rural ultra-poor in SSA. Price volatility is significant and leaves both producers and consumers vulnerable to sharp seasonal swings in markets. Add to this the fact that more than 95% of agricultural land in SSA is rainfed and

particularly vulnerable to climate shocks. Pests and diseases also cause massive crop and livestock losses in much of SSA. And violent conflict has been a major burden on rural Africans, aggravating routine but pervasive insecurity of property rights due to weak tenurial institutions as well as to poor police protection. Furthermore, Africa is the only continent where infectious diseases cause more deaths than non-communicable illnesses, underscoring the severity of covariate human health risks that are especially difficult to manage.

Second, risk exposure tends also to be inversely related to standards of living, with the poorest bearing the greatest uninsured risks. For example, as soil quality declines, a parallel decline in crop vigor makes plants more susceptible to abiotic and biotic stresses; soil-borne pests and diseases appear to especially thrive under these conditions. Mycotoxins, such as aflatoxin, provide another example of an insidious threat that is particularly pronounced in poorer areas and among people who have less access to proper storage technologies and to food distributions systems with reliable food safety controls. Aflatoxin is immunosuppressive, growth-retardant and carcinogenic at lower concentrations and lethal at higher concentrations. Ill-nourished animals, like ill-nourished humans, have compromised immune function and are less productive and more susceptible to disease than their adequately fed counterparts. Meanwhile crime rates are commonly higher in poorer and more remote regions (Fafchamps and Moser 2003).

Third, the most relevant risks faced by different subpopulations are highly context specific. The most serious risks born by the rural poor vary markedly across space and time, even among seemingly homogeneous populations (Doss et al. forthcoming). Wealthy households owning large herds or enjoying high-paying salaried employment may bear considerable animal disease and unemployment risk, while poorer neighbors face relatively greater likelihood of contracting serious disease or facing a disastrous staple food price spike. There are not many multiple hazard risk management options available, especially in rural areas.

Effective risk management therefore involves two distinct threads: risk reduction to dampen ex ante risk exposure and risk transfer to diffuse the impacts ex post of unavoidable shocks that occur. The primary means of risk reduction for the ultra-poor involve improvements to crop

and livestock production systems, through improved cultivars, (animal, human and plant) disease control, water management systems, and increased access to diversification opportunities to as to build portfolios of activities offering weakly correlated returns. There is real progress in this arena. For example, improved maize cultivars that tolerate drought are coming online now, helping maize farmers in stress-prone areas of southern Africa, while new varieties of rice that survive flooding are being tested, and the new rices for Africa (NERICAs) have demonstrated a remarkable capacity to combine higher yield with resistance to local abiotic and biotic stresses in west and central Africa. Meso-level institutions associated with the establishment and maintenance of law and order and with control of infectious diseases are critical as well. Unfortunately, there has been less progress in these areas.

In high-income countries, financial systems and highly integrated markets provide the central means of risk transfer. The underdeveloped state of African rural financial systems and the spatially segmented nature of many rural food markets in SSA sharply limit risk transfer opportunities. Instead, there has been excessive dependence on external assistance in the form of emergency food aid relief and other instruments. But advances in food aid programming (Barrett and Maxwell 2005) and in the design of index-based risk finance instruments (Barnett et al. forthcoming) show great promise for rapid progress in this area in the coming decade.

Principle 4: Facilitate favorable transitions out of agriculture.

The final principle is necessarily ironic. Because agricultural productivity growth naturally stimulates relative contraction in the agricultural sector, relative to secondary and tertiary sectors, efforts to improve food systems must be accompanied by measures to help foster deliberate migration into non-farm livelihoods. Clearly, these must be of the demand-pull variety, not driven by catastrophic loss of agricultural assets. But in all past cases of successful agriculture-led growth, falling real food prices and stimulus to non-agricultural labor demand have consistently fostered such agricultural and rural transformation (Timmer 2002).

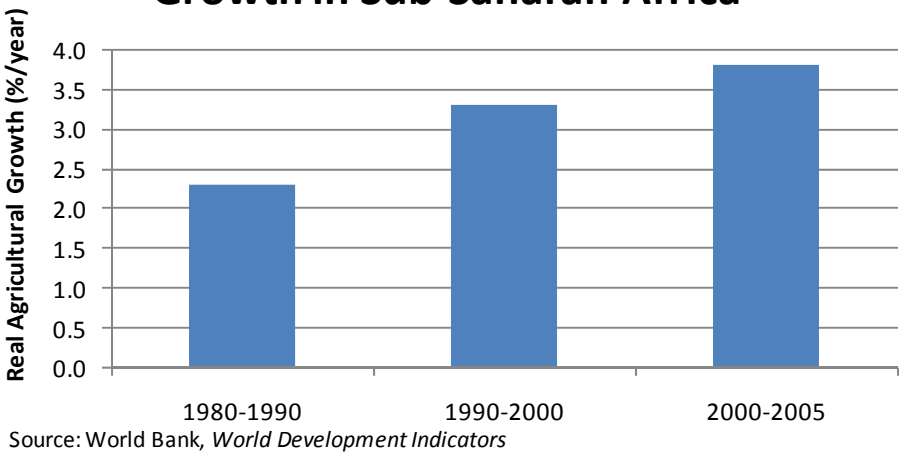
The key here is to help the current generation of adults improve their on-farm productivity so that they can invest in the health, nutrition and education of their children, thereby

equipping the next generation with the human capital necessary to leave agriculture if and when the opportunity presents itself. In particular, and most appropriate to our focus on the ultra-poor of rural Africa, this underscores the especially high returns in adulthood to investments in disadvantaged children very early in life. Studies such as Heckman (2006) and Behrman et al. (2007) provide strong evidence in support of the hypothesis that early childhood (including prenatal and neonatal) health, nutrition and educational interventions have a strong effect on adult cognitive and physical performance and thus on earnings. Hoddinott et al. (2008) provide strong evidence that improved nutrition early in childhood led to significantly higher wages and total earnings among rural Guatemalans. Although there is no similar empirical evidence base from Africa – an important research gap waiting to be filled – the logic and moral imperative of these results carries over directly. We know that early childhood investments in readying the next generation for a transition out of agriculture is essential for breaking out of ultra-poverty/ultra-hunger/ill-health trap in the long-run.

Conclusions

Given the poor past performance of food systems in sub-Saharan Africa and the region's discouraging trends in poverty and hunger, especially ultra-poverty and ultra-hunger, one might be inclined to think that there is no hope for agriculture-led poverty reduction. Yet, there is real reason for hope in SSA. Real agricultural output growth rates are accelerating in SSA, nearly doubling from the 1980s rate so that per capita food output is growing again in SSA (Figure 3). More importantly, this contributes directly to falling rural poverty rates in countries enjoying increased agricultural productivity (e.g., Ghana).

Figure 3: Accelerating Agricultural Growth in Sub-Saharan Africa



Source: World Bank, *World Development Indicators*

Moreover, there is reason for optimism thanks to bold new initiatives such as the joint Gates-Rockefeller Alliance for a Green Revolution in Africa, and the prospect of renewed attention being paid to agriculture in Africa, as reflected in the World Bank's dedication of its flagship *World Development Report* to the topic for the first time in a quarter century. Yield gaps – the difference between realized output and agronomic potential – remain significant in SSA, so the opportunities to achieve significant gains in short order are very real. And although aid to agriculture for SSA declined by roughly half from the late 1980s through 2002, it is now slowly turning around. Private investment in SSA is likewise picking up, with important innovations throughout food systems, from development of improved crop varieties and fertilizers to the introduction of modern agrifood supply chain management systems. While there is no guarantee that these emerging opportunities will benefit the rural ultra-poor, such opportunities are necessary (albeit not sufficient) for progress. The prospects for agriculture-led reduction in poverty, ill health and hunger in SSA are very real.

This is good news because the apparent ultra-poverty/ultra-hunger/ill-health trap in rural SSA implies that intervention is essential if people are to escape and avoid persistent poverty. Recognizing the need for some sort of intervention is the easy part, however. While intervention is valuable, indeed essential, and the four key principles identified above provide clear direction, there remains only limited empirical evidence to guide detailed design and

implementation of strategies to develop African food systems so as to break the lock of poverty and hunger traps.

The 1980s/90s structural adjustment era of economic reforms focused on reaping static efficiency gains from removing policies that distorted resource allocation. Unfortunately, policy design in that era was based on empirically flawed assumptions and the structural adjustment approach largely failed to stimulate either macro-level economic growth and balance of payments stability, or reduction of poverty, ill health or hunger in SSA. The focus of the policymaking and donor communities has thankfully shifted over the past decade from static concerns about "getting prices right" to dynamic concerns about incentives to innovate, invest and grow out of poverty over time, i.e., to finding "pathways from poverty". Today, growing attention is focusing instead on how best to stimulate investment incentives, productivity growth, risk management and productive transitions out of agriculture. These broad foci are appropriate and reasonably well-grounded in both theory and empirical evidence.

But just as the (empirical and theoretical) evidence base was relatively thin at the outset of the structural adjustment era, so too does our current knowledge about the dynamics of reducing poverty, ill health and hunger remain disturbingly limited today in several key areas. So we need to proceed with caution and remain vigilant about rigorously investigating the premises that underpin policy designs and re-evaluating policies as the evidence base grows and sheds new light on what works best under which conditions.

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