POLICY SYNTHESIS
FOOD SECURITY RESEARCH PROJECT-ZAMBIA
Ministry of Agriculture & Cooperatives, Agricultural Consultative Forum, Michigan State University and Golden Valley Agricultural Research Trust (GART) – Lusaka Zambia
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RETURNS TO INVESTMENT IN AGRICULTURE

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Key Messages:

- Investment in agriculture is necessary for ensuring rapid economic growth and poverty reduction in Zambia, as elsewhere in Africa. Yet many of the key investments required to accelerate agricultural growth – technological research, rural infrastructure and market standards, organization and enforcement -- are public goods. Because the private sector cannot capture gains from these investments, they will not invest in amounts sufficient to ensure broad-based agricultural growth. Therefore, the public sector needs to provide the necessary research, transport and market infrastructure necessary to stimulate agricultural growth.
- Zambia currently allocates 6% of government outlays for agriculture. This is less that the 10% commitment Zambia has made under the CAADP agreement and far less than the 15% spent by Asian countries at the launch of their Green Revolution.
- In allocating these funds, Zambia spends the majority of its discretionary agricultural budget on recurrent subsidies for private farm inputs, primarily fertilizer, while spending far less on rural infrastructure and technology development. Yet international evidence suggests that returns to private input subsidies are typically lower than returns to investments in public goods, in part because private input subsidies are prone to rent-seeking and in part because public input subsidies substitute for private financing of these private inputs. Investment in public goods such as agricultural research and extension, rural roads and irrigation typically produce returns two to six times greater than spending devoted to input subsidies. Therefore, a reorientation of public spending, away from private input subsidies and towards increased investment in public goods, would likely accelerate agricultural growth in Zambia.

1. WHY INVEST IN AGRICULTURE?

1.1. Economic growth. Economic growth, structural transformation and wide-scale poverty reduction all require productivity gains in agriculture. Economic growth in Africa, where 75% of the labor force works in agriculture, will require significant improvements in agricultural technology to bridge the startling gap in farm productivity between African and developing regions of Asia and Latin America (Table 1). Structural transformation, the process by which rich countries have developed diversified, affluent economies, normally requires a transfer of resources from agriculture to other sectors of the economy. But this transfer cannot take place without prior productivity gains in agriculture, which permit the release of labor and capital without reducing farm output and raising food prices (Timmer, 1988).

1.2. Poverty reduction. Agriculture likewise serves as a powerful engine of poverty reduction. In Africa, where 70% of the poor work primarily in agriculture, acceleration of agricultural productivity growth offers a potentially powerful tool for spearheading broad-based income gains among the rural poor (Christiansen and Demery, 2006). According to Michael Lipton, “no country has achieved mass dollar poverty reduction without prior investment in agriculture” (Lipton, 2005). England’s agricultural revolution of the mid-1700’s set the stage for its subsequent industrial revolution (Timmer, 1974). In India’s Green Revolution of the 1960’s and 1970s, new technology launched rapid agricultural growth and significant poverty reduction from the

1970's onwards (Hazell, Fan and Thorat, 1999). In China, strong commitment to agricultural research and complementary rural investments triggered significant agricultural productivity gains, setting the stage for large-scale rural poverty reduction from the 1980's onwards (Fan, Zhang and Zhang, 2003) (Figure 1). In Africa, recent evidence from Uganda suggests that sustained agricultural productivity gains have likewise triggered rapid poverty reduction there (Fan et al, 2005). Even Africa's urban poor, who spend the majority of their income on food, see their real incomes rise when growing agricultural productivity and output enable reduction in staple food prices. Only growing agricultural productivity can simultaneously reduce food prices, which govern real incomes and poverty in urban areas, and increase incomes of the majority of Africa's poor, who work in agriculture.

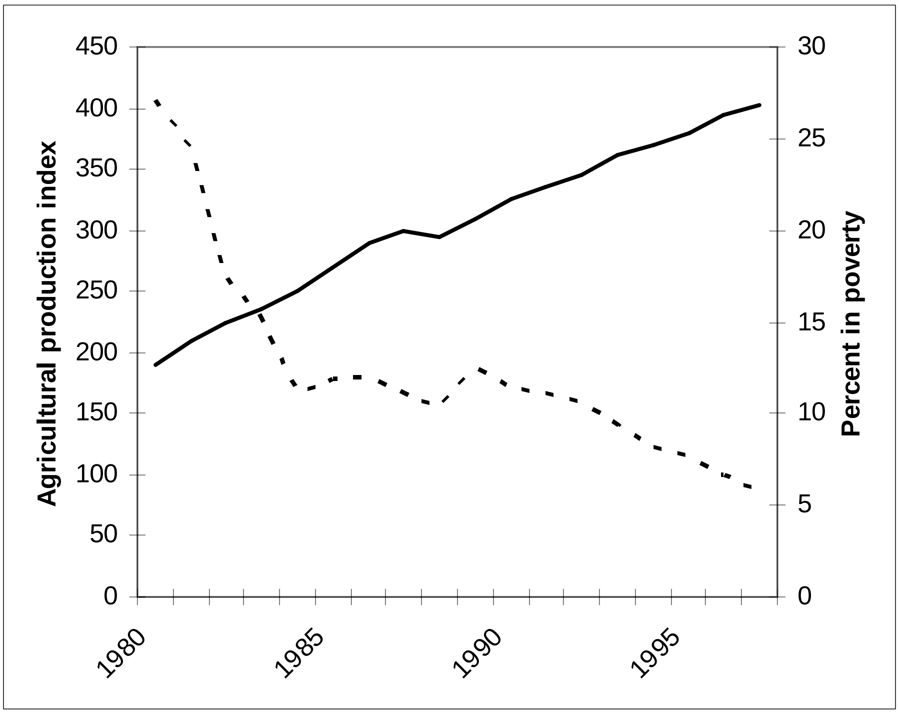
Table 1. Differences in Agricultural Productivity and Welfare Across Developing Regions

	Africa, Sub-Saharan	South Asia*	East Asia	Latin America
Cereal yields, 2005 (tons/ha)	0.9	2.8		3.0
Value of agricultural production per farm population	$198	$393		$1,856
Undernourishment, 2004 (% of population)	32	21	12	10
Malnutrition, 2004 (% children under 5, weight for age)	29	45	15	7
Poverty headcount, 2001 (% under $1 per day)	44	31	12	9
Per capita income, 2004 ($US)	$607	$598	$1,417	$3,584

* Agricultural data refer to developing Asia

Source: World Development Indicators, 2006.

Figure 1. Trends in Agricultural Production and Poverty in China



1.3. Sustainability of agricultural growth. In domesticated agricultural systems, humans assume responsibility for the survival of plant species. Yet plant breeders note that domestication by humans has generally involved deselecting for traits critical to species survival in nature (Evans, 2000; Harlan, 1997). While plants stagger germination of their seeds to ensure survival in the face of uncertain weather, humans breed for uniform germination. While plants devote large energy to development of roots and other organs necessary to ensure plant survival across seasons, humans select for disproportionate biomass concentration in the edible reproductive organs. While natural selection among wild plants favors maximum seed dispersal, to enhance prospects for reproductive success, humans select for non-shattering varieties to reduce labor costs and increase harvested yields. Because human farmers and researchers have deliberately bred key natural survival traits out of the plants and animals they domesticated, these species typically cannot survive in the wild. As a result, the survival of domesticated agriculture depends fundamentally on well-functioning human agricultural research institutions, both on-farm and off.

Given rapid mutation of pests and diseases, domesticated animals and plants rapidly succumb to these predations unless human research systems can develop resistant varieties or chemical and biological controls. In the US agricultural research system, over 50% of all wheat research is devoted to maintenance breeding, simply to maintain yields in the face of ever-evolving strains of wheat rust. In Uganda, cassava production fell 75% in five years following the outbreak of a new strain of cassava mosaic virus in 1989 (Otim-Nape, 2005). Zambian cassava production fell over 30% during the early 1980's following invasion of the cassava mealybug (Chitundu, 1992). In both cases, rapid response by research systems responded successfully, in Uganda through introduction of resistant varieties and in Zambia and elsewhere through internationally supported biological pest control. For domesticated agricultural systems, investments in agricultural research are not only necessary for the growth of agricultural systems, but for their very survival.

1.4. Public goods. Many of the investments necessary to sustain agricultural productivity growth are what economists refer to as "public goods". The private sector will not supply them because they cannot recoup their investments. Private seed companies will produce hybrid seeds for sale because farmers must return to them each season to purchase more seed. But with closed-pollinating crops, such as rice, or cross-pollinating varieties of maize or vegetatively propagated crops, such as sweet potatoes and cassava, farmers can retain planting stock from prior seasons. Because private companies cannot make money selling seeds year after year, they inevitably underinvest in research for these important crops. Roads provide another example. Private firms will not invest in road construction or maintenance, except on their own plantations, because they cannot exclude people from public roadways to defray their investment costs.

Where externalities arise, as with plant and animal diseases, private farms and firms will typically underinvest in preventative measures. This creates a strong case for public investment in combating these types of agricultural pests and diseases. As a result, broad-based agricultural growth cannot take place without ongoing government commitment to supply the technology, infrastructure, markets and disease control systems that are essential for sustaining agricultural growth.

2. NEPAD–THE MAPUTO COMMITMENT

African leaders, through the New Partnership for Africa's Development (NEPAD) initiative, have increasingly underlined the importance of accelerating agricultural growth in Africa. They believe that enhanced agricultural performance will constitute a necessary centerpiece of broad-based poverty reduction efforts across the continent (CAADP, 2005). For this reason, NEPAD's Comprehensive African Agricultural Development Programme (CAADP) calls for a 6% growth rate in agriculture.

Recognizing the critical need for public investments to enable this agricultural growth, African Heads of State and Government, have agreed to increase their budgetary allocations for agriculture to 10% of total outlays by 2008. This represents a substantial increase from the current average of 6% (CAADP, 2005; Fan and Rao, 2004).

Zambia, like other governments, has pledged to increase spending on agriculture to 10% of budget outlays. But since 2003, Zambia has not attained this level of agricultural spending. During the past three calendar years, allocations for agriculture have ranged between 5 and 6% of total spending (Govereh et al., 2006).

The quality of agricultural spending matters as much as the quantity. Clearly, spending in some areas and activities will prove more productive than in others. Currently, Zambia spends over 60% of its discretionary agricultural budget on recurrent subsidies, with half going to subsidize fertilizer for selected individual farmers and a further 12% for maize price supports through the Food Reserve Agency (Table 2). Roughly 5% of discretionary spending goes for investments in roads and irrigation, while the remaining on-third finances recurrent costs necessary for operating the ministry administrative functions as well as its agricultural research and extension programs. Without more specific details, it is difficult to say how much of these recurrent expenditures are invested in supplies and materials required to finance Zambia's agricultural research system. What is clear, however, is that the single largest line item in the agricultural budget goes for fertilizer subsidies to individual farmers.

As an aid in ongoing budget deliberations, this brief summarizes available evidence on the returns to various forms of agricultural spending. Because comparatively few detailed benefit/cost studies have been conducted in Zambia, this brief relies primarily on available evidence from around the developing world.

3. RECURRENT SUBSIDIES FOR PRIVATE INPUTS

In general, recurrent subsidies for private inputs generate low returns. Studies from Latin America reveal negative returns in many cases, due to high levels of corruption, crowding out of private input purchases, resource misallocation and consequent inefficiencies in input use. Estimates from 15 Latin American studies indicate that a 1% increase in budget share for agricultural input subsidies *reduces* per capita agricultural income by 0.3% to 0.5% (Lopez, 2005).

In some instances, however, input subsidies to individual farmers produce positive returns. This was particularly true in the early decades of the Green Revolution in Asia, where subsidies were used to enable small farmers to adopt new irrigated technology packages (Table 3). In general, input subsidies work best where new technology becomes available, farmers control water and have good extension support. None of these conditions currently holds in Zambia. Even in Green Revolution Asia, where these conditions did prevail, returns to input subsidies have typically trended downwards over time (Table 3).

Table 2. Zambian Government Budget Allocation for Agriculture, 2006

	Total spending		Discretionary Spending	
Spending category	billion Kwa	percent	billion K	percent
Subsidies				
Fertilizer	214	33%	214	51%
Output prices	50	8%	50	12%
Operating expenditure				
personnel	84	13%	84	20%
operating costs	51	8%	51	12%
Donor supported development and poverty reduction	227	35%		
Public investments				
capital spending	1	0%	1	0%
irrigation	18	3%	18	4%
Total	645	100%	418	100%

Source: Govereh, Malamo and Shawa (2006).

Table 3. Returns* to Private Input Subsidies and Long-Term Investments in Public Goods

	India	
	1960's	1990's
Recurrent subsidies on private farm inputs		
Farm credit	3.9	0.0
Fertilizer	2.4	0.5
Irrigation costs	2.2	0.0
Power	1.2	0.6
Long-term Invesment in public goods		
Roads	8.8	3.2
Education	6.0	1.5
Agricultural research	3.1	6.9

* Increase in agricultural GDP (rupees) per rupee of spending

Source: Fan, Thorat and Rao (2004).

Even where they are positive, returns to private input subsidies are typically lower than returns to investments in public goods. During the 1960's, public investments produced returns roughly double those of private input subsidies, while during the 1990's public investments produced returns six times as great (Table 3). This difference arises, in part, because input subsidies for private goods encourage rent-seeking as farmers lobby to receive the income transfer these subsidies represent. Moreover, government subsidies tend to undercut private input sales. In Zambia, FSP fertilizer subsidies reduce private fertilizer sales by roughly 75% in accessible areas that are well-served by private sector fertilizer distributors (Govereh and Jayne, 2007).

In addition, because fertilizer and other farm inputs are private goods, subsidies to individual farmers displace funds that these farmers would otherwise spend purchasing inputs. Evidence from Zambia's FSP indicates that fertilizer subsidy recipients are typically the better off farmers (Table 4). Their counterparts, who receive no input subsidy, purchase fertilizer and produce for the market at roughly comparable rates to the subsidized farmers.

Table 4. Characteristics of Households Receiving Fertilizer Subsidies in Zambia, 2002/3

Fertilizer source	Household welfare			Maize marketing	
	Income	Assets	Land	net sellers	net buyers
	000K/capita		ha/capita		
No fertilizer used	266	173	0.15	20%	48%
Private sector purchase	774	342	0.2	46%	32%
Subsidized public supply (FSP)	804	425	0.23	51%	22%

Source: Govereh, Jayne, Black et al. (2006).

So the incremental output gain produced by these targeted subsidies appears to be quite small. For this reason, returns to fertilizer subsidies in Zambia appear to be quite low (Precise estimates of returns to FSP subsidies are currently under way and will be published in the near future by FSRP and MACO).

4. INVESTMENTS IN PUBLIC GOODS

Agricultural research and extension typically generate the highest returns of any form of agricultural spending. A recent summary of over 600 rate of return studies suggests that returns to agricultural research average 50% in Africa, 78% in Asia and 54% in Latin America (Allston et al, 2005). Variability of outcomes is, however, highest in Africa, and, in specific instances, returns may even prove negative. The diversity of Africa's farming systems and frequent reliance on rainfed crop production contribute to this high variability. Median returns, however, remain consistently higher than any other form of public investment. In Zambia, for example, investments in root and tuber crop research during the 1980's and 1990's has led to several rounds of new varietal releases of cassava and sweet potatoes, triggering a productivity surge in both of these food staples (Govereh et al. 2006).

Public investment in roads and irrigation, likewise, generates generally strong returns (Table 5). As a general rule, investments in secondary roads prove more productive in stimulating agricultural growth than do investments in paved roads (Fan et al, 2004). Investment in irrigation infrastructure, likewise, proves profitable in many circumstances, although returns vary considerably by location (Table 6) and over time (Table 3)

Table 5. Returns* to Investment in Agricultural Public Goods

Spending category	China	India	Thailand	Uganda	Viet Nam
Research	9.6	13.5	12.6	12.4	12.2
Irrigation	1.9	1.4	0.7		0.4
Roads	2.1	5.3	0.9		3
feeder	1.5			7.2	
paved	n.s.			n.s.	
Electricity	0.5	0.3	4.9		n.s.
Telephones	1.9				n.s.
Education	3.7	1.4	2.1	2.7	2.1
Health		0.9		0.9	

* Returns = $ increase in agricultural output per $ of incremental spending.
n.s. = not statistically significant

Sources: Fan, Zhang and Zhang (2002); Fan, Hazell and Thorat (2000), Fan, Zhang a

Agricultural growth requires continual improvements in farm technology, well functioning markets and infrastructure adequate to move goods at reasonable cost from farm to market. In all three areas, public goods are essential. Technology development in closed pollinating and vegetatively propagated crops requires publicly funded research and extension services. Well-functioning markets require property rights, grades and standards and enforceable contracts, which are typically public goods. Infrastructure, such as farm-to-market roads, power lines and ports are, likewise, normally public goods. So, in general, public good remain critical to ensuring agricultural productivity and income growth.

5. IMPLICATIONS

Quantitatively, Zambia spends about 6% of its budget on agriculture, significantly less that the 10% CAADP target to which Zambia committed in 2003. Nor does current spending come close to the 15% Asian countries devoted to agriculture during the Green Revolution years (Fan and Rao, 2003).

Table 6. Regional Variation in Returns to Public Investment in Agriculture

	R&D	Roads*	Education	Irrigation	Telecoms
Uganda					
East	10.8	8.7	3.5	-	-
North	11.8	4.9	2.1	-	-
Central	12.5	6.0	2.1	-	-
West	14.7	9.2	3.8	-	-
all Uganda	12.3	7.2	2.7	-	-
China					
Coastal	8.6	8.4	9.8	2.4	7.1
Central	10.0	3.8	3.7	1.8	2.6
Western	12.7	4.3	5.1	1.6	4.1
all China	9.6	8.8	8.7	1.9	7.0

* In Uganda, refers to feeder roads.
- not evaluated for Uganda

Sources: Fan, Zhang and Rao (2004) and Fan et al. (2003).

Qualitatively, Zambia spends the majority of its discretionary resources on recurrent subsidies for private inputs. Though politically popular, these subsidies are typically less effective at stimulating agricultural growth than investments in research, extension, roads and other public goods, because the input subsidies displace private spending that would otherwise occur. They are also prone to diversion and manipulation.

Recurrent spending on input subsidies for private goods competes directly with long-term investment allocations for public goods such as roads, rural education, and agricultural research. Given the extremely low level of public investment in agricultural research in Zambia, the cost of this neglect is likely to be high. The gradual decay of Zambia's public agricultural research system leaves Zambian farmers increasingly vulnerable to the emergence of new pests and viruses. Without a steady stream of new genetic material, productivity of crops and livestock will fall over time. Available evidence suggests that investment in public goods such as agricultural research, extension and roads constitutes one of the most effective tools available for stimulating economic growth and poverty reduction. Therefore, a reorientation of spending, away from private input subsidies and towards increased investment in public goods, would likely accelerate agricultural growth in Zambia.

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