ReSAKSS
Regional Strategic Analysis and Knowledge Support System
Africa Wide

ReSAKSS Working Paper No. 25

February 2009

Investing in African Agriculture to Halve Poverty by 2015

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Fan, Shenggen; Johnson, Michael; Saurkar, Anuja; Makombe, Tsitsi. 2009. *Investing in African Agriculture to Halve Poverty by 2015*. ReSAKSS Working Paper No. 25. International Food Policy Research Institute (IFPRI).

A previous version of this paper was published in February 2008 as IFPRI Discussion Paper 00751 and is also available for download at http://www.ifpri.org/pubs/dp/ifpridp00751.pdf .

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ABSTRACT

This paper proposes a simple methodology to estimate the agricultural spending that will be required to achieve the Millennium Development Goal of halving poverty by 2015 (MDG1) in 30 sub-Saharan African countries. This method uses growth-poverty and growth-expenditure elasticities to estimate the financial resources required to meet the MDG1, considering both the direct and indirect impacts of agricultural spending on poverty reduction. The paper attempts to address a key knowledge gap by improving estimation of MDG costs at both the regional and country levels.

Keywords: poverty, Millennium Development Goals, investment, Sub-Saharan Africa, agriculture

1. INTRODUCTION

Developing countries and the international development community are presently increasing and redirecting their resources in order to achieve various development objectives such as reductions in poverty, hunger and malnutrition. At the United Nations Millennium Summit in September 2000, world leaders made a huge commitment to reducing poverty. As part of the process, specific indicators were adopted for measurement of quantifiable progress, and an agenda was enacted for reducing poverty, and its causes and manifestations.[1] At the Monterrey Conference of 2002, rich countries renewed their pledge to increase their development assistance, raising it from 0.4 percent in 2004 to 0.7 percent of their GDP. In 2005, the UN Millennium Project, headed by Jeffery Sachs, also called for a 'big push' in donor support to meet the MDG challenge. In the same year, the Commission for Africa asked rich countries to double their aid to Africa and cancel the debts of poor African countries.

Many developing countries have also adopted the concept of the Poverty Reduction Strategy Papers (PRSPs) or an equivalent, in order to formulate strategic plans and earmark financial resources for achieving their poverty reduction goals. In 2001, the New Partnership for Africa's Development (NEPAD) was formed by the Assembly of Heads of State in Africa as part of an explicit political and resource commitment to foster growth and development and address the challenges facing the African continent.

However, despite these international, regional and national efforts, several key questions remain. For example, it is yet unclear whether the pledged resources are sufficient to achieve the stated objectives of growth and poverty reduction, nor is it clear how and under what conditions these resources should be allocated in order to have the largest impact on growth and the poor. Several studies have attempted to estimate the overall amount of resources required across all MDGs. However, no prior study has explicitly focused on examining the required spending in agriculture and breaking it down by individual country.

The importance of the agricultural sector in reducing poverty and serving as an engine of growth was demonstrated throughout the Green Revolution in Asia, particularly in India and China. Africa cannot bypass this development pathway, as the bulk of the African population lives in rural areas.[2] Recent evidence from the International Food Policy Research Institute (IFPRI) showed that promoting higher agricultural growth will be key in reducing poverty, promoting overall economic growth and achieving the first MDG goal of halving the number of poor people (Diao et al., 2007).

[1] The eight goals include cutting poverty and hunger by half, improving education, health and nutrition, and enhancing development partnerships.

[2] At least 70 percent of the workforce is at least partially engaged in agriculture and earns an income of between $0.33 and $0.80 per day (UNDP Report; 2002, and Ashley and Maxwell, 2001).

There are a range of instruments that governments and donors can use to promote the required agricultural growth in Africa. Among them, government spending is one of the most direct and effective methods, yet agricultural spending in Africa remains very low when compared with that in other developing regions. For example, Africa still spends only 4-5 percent of its total national budget on agriculture, compared with 8-14 percent in Asia. During the Green Revolution period in Asia, this share was even larger (upwards of 15 percent). Agricultural expenditure as a percentage of agricultural GDP is a more appropriate measure of a government's support for agriculture, as it measures agricultural spending relative to the size of the sector. However, even by this measure, African countries spend only 4-5 percent compared to 8.5-11 percent in Asia (Fan et al., 2008).

The importance of increasing government spending for agriculture has been recognized by African leaders as a fundamental pre-requisite for achieving a 6 percent annual growth rate in agricultural GDP, a goal that has been adopted by NEPAD through the Comprehensive Africa Agriculture Development Programme (CAADP). This is evident in the Maputo Declaration, wherein African leaders called for a 10 percent budget allocation to agriculture by 2008, as part of their commitment to the MDG1 and CAADP goals. These well-intentioned efforts have generated debate in the international development community regarding the level and utilization of resources, especially given that agriculture is a neglected sector, with problems that may be exacerbated by drought, insecurity and unfavorable policies towards farmers. The objective of this paper is to develop a simple approach for estimating the financial resources required to achieve the MDG1 through agricultural growth. This is accomplished by first calculating the required agricultural growth rates using elasticities of poverty reduction with respect to agricultural growth. The calculated required growth rates are then used to estimate the necessary financial resources, using growth with respect to expenditure elasticity. Because growth in the non-agricultural sector will also contribute to poverty reduction, either directly or indirectly through growth linkages with agriculture, the additional poverty reduction effects from this sector are also considered in the analysis.

The paper is organized as follows: We first review various approaches in assessing the resources required for achieving the MDGs. We then develop our own approach and focus on the estimation of agricultural growth and financial resources required for achieving the MDG1, followed by a discussion of our estimated results. We conclude the paper by pointing out future research directions and remaining knowledge gaps.

2. COSTING THE MDG

The adoption of the MDGs as a development framework among developing countries has engendered various efforts to estimate their achievement costs. Most such estimates have been made at the global or regional levels, with some country-level studies emerging only recently.

One of the earliest of such studies is the Report of the High Level Panel on Financing for Development (or the "Zedillio Report") published by the United Nations. Subsequent studies by the World Bank, the United Nations Development Program (UNDP), and the IFPRI's IMPACT model also estimate the costs required to reach the MDGs. The various estimates of the total cost to halve poverty and hunger by 2015 (the MDG1) differ significantly, ranging from $8.5 billion to $62 billion per year. This wide variation in cost estimates arises from differences in methodological approaches, data quality and sources, underlying assumptions about future population growth, target interpretation, countries covered, unit costs of investments, and the parameters used in linking investment to growth and poverty reduction. The most commonly used approach is the standard unit cost method based on estimates of a minimum expenditure requirement per person or sectoral cost estimates.

In the Zedillo report, resource requirements (or investment gaps) for achieving growth in Africa are estimated from the capital account deficit (investment minus savings). The calculation assumes that a 22 percent investment ratio as a percentage of GDP would be required to sustain an economic growth rate of 6 percent over the next 10-12 years, from a baseline of data from 1994-98. This assumption is derived from the Latin American experience.[3] Using this approach, the study estimates that an additional $10 billion per year over current spending will be needed to achieve a 6 percent economic growth rate and meet the MDG1 in Africa.

The World Bank study by Devarajan, Miller, and Swanson (2002) first estimates the additional income growth required to meet the MDG1, then estimates the resources needed to achieve this growth. This is done with a "two gap" model in which growth in mean income depends on the level of investment and the efficiency with which investment is turned into output, i.e. the incremental capital-output ratio (ICOR). The growth in mean income is calculated using a Lorenz curve estimated for each country, based on current poverty levels and income distribution. The estimates for Africa range from $54 to $62 billion per year.

IFPRI's IMPACT model employs unit costs to estimate global- and regional-level requirements necessary to meet the MDGs. For example, total irrigation investments are calculated by multiplying the estimated increase in irrigation area, and then adjusting for cropping areas by the average cost of

[3] Estimates based on the Latin American experience suggest that in order to sustain 6 percent growth, an investment rate of 28 percent of GDP is needed. The Zedillo Report assumes that similar rates of investment will be required for other less developed economies.

irrigation per hectare. Similarly, rural road investments are calculated by multiplying the incremental road length by road investment costs per unit. The model projects a total required investment of $238 billion during 1997-2025 for Africa (Rosegrant et al., 2005).[4] The total agricultural investments, i.e. the sum of the estimated costs for irrigation, rural roads and agricultural research, amounted to roughly $140 billion, an average of $5 billion a year. Achieving these projections would entail a 94 percent increase in total investments for Africa over the business as usual (BAU) scenario;[5] rural road investments would rise 56 percent above the BAU levels of $95 billion, while irrigation and agricultural research investments would increase by 141 percent and 44 percent above the BAU estimates of $49 billion and $28 billion, respectively.

The UNDP has also commissioned several studies, including a background study by Pettifor and Greenhill (2003) that draws on the approaches used in both the Zedillo and World Bank reports to come up with global estimates of $46 billion per year needed to meet the MDG1 among 42 heavily indebted countries. Another UN effort, that of the Millennium Project, developed a Hunger Model that uses the unit cost approach to estimate the country-specific resource needed to achieve the MDG1 through agricultural productivity growth, rural income generation and nutrition improvements. The Hunger Model is one of only a few efforts that have attempted to generate cost estimates at the level of individual countries. The model allows users to calculate inputs, the per capita and total costs of providing interventions, and the human resources and physical infrastructures required to achieve the targets. These parameters are projected based on the change in coverage required and unit cost. Country-level studies have been carried out for Ghana, Tanzania and Uganda, yielding estimates that the annual public investments needed per capita in these countries to achieve the MDGs would be $80, $96 and $92 in 2006, respectively, and increase to $124, $161 and $143 by 2015 (UNDP, 2005).

More recently, an increasing number of individual country-level estimates have emerged. That of Kakwani and Son (2006) is especially noteworthy, as it uses simulations to project required annual growth rates, investment rates and per capita aid across 15 Sub-Saharan African countries. The simulations consider the distribution aspects of growth in each country by linking growth, poverty and inequality through three scenarios: pro-poor, anti-poor and distribution-neutral growth scenarios. The utilized growth elasticity of poverty differs across years and countries based upon these three conditions of growth. For example, the magnitude of growth elasticity for poverty reduction is greatest under the pro-poor scenario, implying that a lower growth rate would be required to achieve the same percentage reduction in poverty. This approach reveals that the pattern of growth and initial conditions of

[4] This projection is part of the 2020 vision scenario projections, which are based on considerable investments in education, HIV/AIDS treatment, and agricultural research and extension. One of the scenarios attempts to show the kind of investments necessary to achieve the MDGs.

[5] The businesses as usual (BAU) scenario estimates are based on the continuation of current food policy and investment trends through 2015.

development are important to calculations aimed at estimating the costs of the MDGs. For the 15 African countries studied, the average per capita growth rate required to achieve the MDG1 is much lower under a pro-poor than an anti-poor development strategy, at 1.5 percent and 5.4 percent, respectively. The investment rates needed to achieve these growth rates are then calculated using an elasticity of investment with respect to growth and an output-to-capital ratio. The results estimated using this strategy show that the required average per capita aid needed is about $35.4 per person under a pro-poor growth strategy, increasing to as much as $129 per person under an anti-poor strategy. Comparison of these results with those from the UNDP Report (2005) reveals a large divergence among individual country estimates,[6] underscoring that there is a lack of consistency at any level of analysis, due to the use of different assumptions, data, and analytical approaches.

One of the key determinants for costing the MDG1 includes the assumptions made about future economic growth and its effects on poverty. In the World Bank study (Devarajan, Miller, and Swanson, 2002), for example, the required investment is calculated based on a per capita growth elasticity of poverty, which is used to first determine the rate at which national income (or GDP) will need to grow in order to achieve the poverty reduction target of the MDG1. Using this approach, a variety of studies estimate the growth rates needed to lift people out of poverty in order to meet the MDG1, but fail to estimate the cost required to achieve the necessary growth (Table 1). For example, Besley and Burgess (2003) provide an estimate of 5.6 percent required growth, while Hanmer and Naschold (2001) distinguish the growth required under pro-poor and anti-poor policy environments, with pro-poor policies lowering the required growth from 5.6 to 2.4 percent. At the country level, Cameroon, Malawi and Tanzania would need to grow at 7, 6 and 5 percent, respectively, which is uniformly faster than their current rates. In contrast, Uganda was found to be on track to achieve the MDG1 with its present growth rate of 5 percent (UNDP 2003). However, although the use of growth elasticities of poverty for these calculations can be more reasonable than available alternatives, it is subject to many problems. For example, the estimates will vary widely depending on the country, type of income being measured, and time frame (see Bourguignon, 2002, and Ravallion and Datt, 1999, for examples). According to Kakwani and Son (2006), one explanation for the wide divergence in these estimates is the varied initial levels of development and degree of income inequality that exits across individual countries.

[6] For Ghana, the UNDP Report (2005) estimates a requirement of $80 per capita in 2006 to achieve the MDG1. Adjusted to current US dollars, Kakwani and Son's (2006) estimate is closer to $57 per capita in 2006. For Uganda, their estimate is $39, compared to the UNDP Report's value of $92.

Table 1. Different approaches for analyzing required resources to meet the MDG1

	Author	Method used	Estimates
1	Zedillo Report	Simulation based on investment required to achieve 6 percent growth	$20 billion per year
2	Devarajan (2002)	Estimates required aid by calculating the average growth rate to reach MDG1 using a two gap growth model which depends upon level of investment and incremental input output ratio (ICOR)	$54-62 billion per year
3	Hunger Model (UN)	Unit cost method	No estimates provided
4	UN Reports (2005)	Unit cost method	a) Ghana, $80 per capita in 2006; b) Tanzania, $96 per capita in 2006; c) Uganda, $92 per capita in 2006
5	Rosegrant et al. (2005)	Unit cost method	$238 billion from 1997-2025
6	Besley and Burgess (2003)	Estimates growth rate required to reach MDG1	5.6 percent
7	Hanmer and Naschold (2001)	Estimates growth rate required to reach MDG1 under pro-poor policies	2.4 percent
8	UNDP (2003)	Estimates at country level of growth required to meet MDG1	a) Cameroon, 7 percent; b) Malawi, 6 percent; c) Tanzania, 5 percent; d) Uganda, 5 percent
9	Kakwani and Son (2006)	Estimates required aid and growth at the country level to reach the MDG1	Growth rate varies at 1.5, 5.4 and 2.4 percent for pro-poor, anti-poor and neutral distributions, respectively

Although the different methodologies utilized to date yield varied estimates, all of the studies reviewed above suggest that the current level of resources needs to be significantly increased to reach the MDG1. Two primary methods for costing the MDGs emerge from these prior reports: unit costs and growth-poverty elasticities. However, there is no consistent analytical basis for the unit cost method. Moreover, estimating costs at the unit level is more difficult for the MDG1 compared to the health or education MDGs. While a number of growth poverty elasticities have been estimated, these studies tend to be limited by data availability and the required parameters. Also, most of the calculations assume that the poor benefit equally from growth, ignoring the fact that the majority of the poor in Africa live in rural areas, where the agricultural sector plays a central role in lifting them out of poverty. Based upon recent evidence of the relative contribution of agriculture to poverty reduction, especially in Africa, the present study estimates the level of resources required by each country in the agricultural sector in order to achieve the MDG1.

Since there is no 'one size fits all' in meeting the MDG and other development goals, needs assessments can only be properly made at the country level. The Poverty Reduction Strategy Papers (PRSPs) are supposed to provide a framework for calculating the additional amount of resources required, but very few countries have done so to date. Furthermore, the studies that include relevant costing calculations often lack a consistent and integrated analytical framework.

3. INVESTING IN AFRICAN AGRICULTURE TO HALVE POVERTY: A SIMPLE SIMULATION MODEL

The principal objective of this study is to estimate the agricultural spending require to achieve the agricultural growth needed to meet the MDG1. The key feature of this study is the examination of potential country-level differences that have been largely ignored by the previous estimates. To accomplish this, we use both growth-poverty and expenditure-growth elasticities to estimate required agricultural growth rates and corresponding public expenditures needed to achieve this goal, separating this out by individual country. The required agricultural growth rates are estimated using elasticities of poverty with respect to both agricultural and non-agricultural growth, and the additional spending needed in agriculture is calculated based on these growth rates and the expenditure elasticities of growth. The model simulations account for the impact of the non-agricultural sector by using non-agricultural growth elasticity of poverty. The share of the non-agricultural sector is expected to increase over time, and thus its impact on poverty reduction may also increase. Therefore, we also consider the non-agricultural sector in order to avoid overestimating the agricultural growth and spending required to achieve the MDG1. The simulations are conducted for the 30 countries in Sub-Saharan Africa (SSA) in which the agricultural sector contributes at least 10 percent of the gross domestic product (GDP) and where the majority of the poor depends upon agriculture for their livelihood. Although the choice of countries is governed by the availability of expenditure data, the included countries broadly cover the whole of SSA. Below, we briefly describe the assumptions and parameters used in conducting this analysis.

Estimation of Required Growth and Spending

To estimate required agricultural growth rates, we begin by decomposing a typical growth elasticity of poverty into the effects of agricultural and non-agriculture growth, and an interaction term that captures the indirect effect of agricultural growth on poverty through its linkage or multiplier effect with non-agricultural growth. This can be represented for each country (and region) as:

$$\frac{dP}{P} = \left(\frac{dP}{P}\frac{Y_{ag}}{dY_{ag}}\right)\frac{dY_{ag}}{Y_{ag}}s_{ag} + \left(\frac{dP}{P}\frac{Y_{ng}}{dY_{ng}}\right)\frac{dY_{ng}}{Y_{ng}}s_{ng} + \left\{\left(\frac{dP}{P}\frac{Y_{ng}}{dY_{ng}}\right)\left(\frac{dY_{ng}}{Y_{ng}}\frac{Y_{ag}}{dY_{ag}}\right)\frac{dY_{ag}}{Y_{ag}}s_{ag}\right\} \qquad (1)$$

where for each country and SSA region,

P = poverty rate
Y_{ag} = agricultural GDP
Y_{ng} = non-agricultural GDP
s_{ag} = share of agriculture in GDP
s_{ng} = share of non-agriculture in GDP.

Equation (1) can be rewritten as:

$$\dot{P} = \left\{\varepsilon_{ag} * g_{ag}\right\} * s_{ag} + \left\{\varepsilon_{ng} * g_{ng}\right\} * s_{ng} + \left\{\left(\varepsilon_{ng} * \phi_{ng,ag}\right) * g_{ag}\right\} * s_{ag} \quad (2)$$

where for each country and SSA region,

$\dot{P}$ = change in poverty for each year

ε_{ag} = elasticity of poverty reduction with respect to (w.r.t.) agricultural GDP growth

ε_{ng} = elasticity of poverty reduction w.r.t. non-agricultural GDP growth

g_{ag} = agricultural GDP growth rate

g_{ng} = non-agricultural GDP growth rate

$\phi_{ng,ag}$ = multiplier effect or linkage between agricultural GDP growth and non-agricultural GDP growth.

Equation (2), therefore, represents the contributions of agricultural and non-agricultural growth on poverty reduction, weighted by their respective shares in total GDP. The first and second terms measure the direct and independent effects of agricultural and non-agricultural growth on poverty reduction. The third term measures an indirect effect whereby additional reductions in poverty, which result from non-agricultural growth, are solely generated by the multiplier effect or linkage with agricultural growth. Partitioning the expected reduction in poverty among each of the terms in equation (2) and solving for the required agricultural growth rate (as the unknown) yields the following equation:

$$g_{ag} = \left\{\dot{P} - \dot{P}_{ng}\right\} \Big/ \left\{\varepsilon_{ag} * s_{ag} + \left(\varepsilon_{ng} * \phi_{ng,ag}\right) * s_{ag}\right\} \quad (3)$$

where $\dot{P}_{ng}$ = the rate of poverty reduction stemming from a given non-agricultural growth rate, which is calculated from the second term in equation (2), i.e. $\dot{P}_{ng} = \varepsilon_{ng} * g_{ng} * s_{ng}$.

Equation (3) represents the agricultural growth rate that is required to reduce poverty annually from its own direct effect. The difference between the annual rates of poverty reduction needed to achieve the MDG1 and that resulting from non-agricultural growth alone represents the rate of change that will need to come directly from agricultural growth and indirectly from the additional growth in non-agriculture stimulated by the agricultural growth (via the multiplier effect).

To determine the level of public expenditure needed for agriculture to grow at the rates calculated in equation (3), we use recent expenditure elasticities of growth, which measure the rate at which a change in agricultural expenditure will lead to a change in the rate of agricultural growth[7]. Once the required agricultural growth rates are known, the corresponding annual changes in expenditure needed to achieve these growth rates can be calculated as:

[7] One of the thornier problems in calculating the required public resources for growth and poverty reduction targets is the time lag between spending and the actual impact on agricultural production. In this study, for simplicity, we assume that investment is a steady flow of resources to the existing investment stock. In the long run, growth in stock is the same as growth in investment flow.

$$\dot{E}_{ag} = g_{ag} \Big/ \delta_{ag} \tag{4}$$

where

$\dot{E}_{ag}$ = the annual growth rate in agricultural expenditures, or $\frac{dE_{ag}}{E_{ag}}$

δ_{ag} = elasticity of agricultural growth w.r.t. agricultural expenditure growth, or $\frac{dY_{ag}}{dE_{ag}} \frac{E_{ag}}{Y_{ag}}$.

From equation (4), the annual agricultural expenditures required between 2005 and 2015 can be easily calculated from the baseline data on actual agricultural expenditures in 2004.

Data and Parameters

Data on agricultural and non-agricultural growth, population growth and poverty rate and agricultural expenditures over time are needed to quantify the required agricultural spending. The data on agricultural expenditures are primarily obtained from the International Monetary Funds' Government Finance Statistics yearbooks, supplemented from the statistical appendices of the country reports from the IMF and PRSP reports. Although time series data were not available for all 30 countries, this is by far the most comprehensive data set on agricultural and total spending of African governments (at least to the authors' knowledge). To convert expenditures denominated in current local currencies into international dollar aggregates expressed in base year (2000), prices are first deflated from current local currency expenditures to a set of base-year prices using each country's implicit GDP deflator. We then use 2000 exchange rates measured in 2000 purchasing power parity reported by the World Bank Indicators (2006) to convert local currency expenditures measured in terms of 2000 prices into a value aggregate expressed in terms of 2000 international dollars. Agricultural, non-agricultural growth rates and GDP shares are calculated from the World Development Indicators, 2006.

National poverty lines are obtained from the various poverty assessments of each country. This study focuses on the poverty head count ratio, which captures the percentage of people living below a specified threshold of income or consumption. Since not all countries have poverty measures available for 2004, we use the same methodology (equation (2)) to predict the poverty rate for the year by using the poverty reduction elasticities of actual agricultural and non-agricultural growth between the last year in which poverty data is available and 2004.

Since the results are sensitive to the choice of elasticities, we undertake a careful review of the literature to determine the most appropriate values for Sub-Saharan Africa, surveying a vast amount of literature on elasticities for each country and for Africa as a whole[8]. Since the number of countries and

[8] A review of elasticities is provided in appendix tables A.1 and A.2.

frequency of poverty data varies, there are a host of elasticities, many of which are estimated using different methods. Given the sensitivity of these parameters and the need to account for both the 'direct' and 'indirect' effects of the agricultural and non-agricultural sectors on growth and poverty, we chose to use the more recent Africa-wide estimates of Christiaensen. et al. in 2006 (World Bank, 2006). This also avoids inconsistencies of elasticity estimates arising from the use of different methods. The utilized study estimates elasticity of poverty reduction with respect to agricultural GDP in low- and middle-income countries for Africa as -1.83 and -0.76, respectively. Despite differences in the utilized methods and approaches, the elasticities in the country classification (low income) of the Christiaensen et al. study are comparable with the country level estimations done by others. For example, Diao et al. (2005) estimate that the elasticity of poverty reduction to agricultural GDP is -1.66 for Ethiopia. Similar work has been done for Ghana, Kenya, Uganda and Zambia provided in the appendix. These results are comparable to the elasticity for low-income countries reported by Christiaensen et al..

The agricultural to non-agricultural growth multipliers used in our simulation are drawn from Delgado et al. (1998), who estimate them to be 1.5 for Africa versus 1.8 for Asia, implying that for every 1 percent growth in agriculture, at least 0.5 percent growth will be induced in the non-agricultural sector. The utilized expenditure growth elasticities are from Fan and Rao (2003), who report that the elasticity of agricultural spending is 0.32 for Africa.

Finally, to reflect the different economic structures and different roles of agriculture in the economy, we disaggregate the 30 African countries into two groups. The first group, containing 16 countries, represents countries in which agriculture is between 10 and 35 percent as a share of GDP. The second group, containing 14 countries, represents countries in which agriculture contributes substantially to GDP, defined as a share above 35 percent.

Baseline Assumptions and Alternative Scenarios

To estimate the agricultural growth required to meet the MDG1, we assume that the non-agricultural growth rates will fall into two scenarios: the first assumes that the non-AgGDP will grow at the same rate seen during 1990-2004 (*lower bound*), while the second assumes it will grow at the rate seen from 2000-2004 (*upper bound*)[9]. The former provides a more conservative scenario, since growth from 1990 to 2004 was slower for many African countries due to depressed commodity prices, unfavorable weather and political instability. The second represents a more optimistic scenario as many countries have made large strides in the last few years due to strong global commodity demand, improved domestic policy environment and governance, and investment climate.

[9] Any negative growth rate in the non-agricultural sector was adjusted to smooth out any unreasonably large shifts in poverty rates. We assume annual growth rates equivalent to future population growth (1 to 3 percent) under the lower bound, and a minimum 4 percent under the upper bound (which happens to be the SSA average between 2000 and 2004).

4. RESOURCES REQUIRED

Before we analyze what additional resources will be required for African countries to achieve the MDG1, we review the progress of poverty reduction in the past, particularly between 1990 and 2004 (Table 2). Africa as a region has achieved relatively little progress in poverty reduction; indeed, poverty actually increased between 1990 and 2004 in 10 countries (Burundi, Central African Republic, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Niger, Togo and Zimbabwe). Thus, the African countries must accelerate their economic growth if they are to reach the MDG1.

Using growth elasticities and projected growth rates, we can simulate whether a country will be able to halve the number of poor by 2015 (Table 3). It is clear that even under the more optimistic scenario, many African countries will not reach the MDG1 by 2015. Only Ghana, Uganda, Mozambique, Mali, and Cameron will reach the MDG1, while the more conservative scenario has Mali joining the countries that will fail to meet the MDG1. Even if all of the surveyed countries reach the target of 6 percent annual growth in agriculture, most will be unable to reach the MDG1. Even under the more optimistic scenario, only one third of the countries (Burkina Faso, Mauritania, Mozambique, Cameroon, Ethiopia, Ghana, Guinea-Bissau Mali, Nigerian, Rwanda, Togo, and Uganda) will reach the MDG1 if they succeed in achieving 6 percent annual agricultural growth from 2004 to 2015. Under the more conservative scenario, the number of countries that will reach MDG1 is further reduced to 7 (Mozambique, Cameroon, Ethiopia, Ghana, Guinea-Bissau, Togo, and Uganda).

Before we calculate the agricultural spending that will be required to achieve the desired level of agricultural growth, we review what African countries have actually spent on agriculture (Table 4). Agricultural spending as a share of total government spending is about 5 percent, only half of the 10 percent called for by the Maputo declaration. The majority of African countries are far from this target, although many have made significant progress in boosting their government spending on agriculture in recent years. A more appropriate measure is agricultural spending as a percentage of agricultural GDP, since the size of the agricultural sector varies by country and this measure is size-neutral. For Africa as a whole, this percentage is 4.6 percent (2004), which is very low when compared with Asia, which often spends 8-10 percent of its agricultural GDP on agriculture (Fan et al., 2008).

Table 2. Poverty and growth in Africa

Typology	Country	Most Recent Poverty Rates (various years)	MDG Target Poverty Rate by 2015	Annual GDP Growth Rates		Agricul-tural Share in GDP	Annual Agricultural Growth Rates		Non-Agricultural Growth Rates	
				1990-2004	*2000-2004*	*2004*	*1990-2004*	*2000-2004*	*1990-2004*	*2000-2004*
Share of Ag GDP in total GDP>10 percent<35 percent	Burkina Faso [2,4,6]	46.4	28.1	4.2	5.2	31	3.8	5.1	4.4	5.3
	Chad [2]	81.8	40.4	4.0	14.1	21	3.0	0.7	4.3	19.8
	Cote d'Ivoire [2]	33.6	16.2	2.1	-0.6	27	2.7	0.5	1.9	-1.1
	Gambia [2]	57.6	32.0	3.4	3.8	26	3.7	-0.2	3.3	5.3
	Guinea [2,5]	64.0	34.8	4.0	2.9	22	4.5	4.5	3.9	2.5
	Kenya[2]	55.4	24.4	2.3	2.7	25	2.4	1.9	2.2	3.0
	Lesotho [2]	68.0	24.5	3.3	3.1	15	1.6	-1.8	3.6	4.1
	Madagascar [2]	80.7	35.0	2.1	0.9	32	1.8	1.3	2.3	0.7
	Malawi [2,4]	65.3	27.0	3.1	2.9	34	6.8	1.8	1.6	3.5
	Mauritania[2]	46.3	28.3	4.7	4.7	15	2.8	-0.2	5.2	5.8
	Mozambique [2,4]	54.1	37.2	7.2	8.8	27	5.0	8.9	8.2	8.8
	Namibia [1]	33.9	18.0	4.0	4.7	10	3.1	1.2	4.1	5.1
	Senegal [2]	53.9	29.0	3.6	4.4	18	2.6	0.0	3.9	5.5
	Swaziland [1,3]	8.5	5.9	3.0	2.3	8	0.7	-0.3	3.3	2.6
	Zambia [2]	67.0	34.9	1.6	4.4	15	3.2	1.3	1.4	5.0
	Zimbabwe [1]	58.3	16.7	-0.2	-5.9	17	1.4	-9.0	-0.5	-5.2
Share of Ag GDP in total GDP>35 percent	Benin [2]	28.5	13.2	4.9	4.5	42	5.7	5.7	4.4	3.7
	Burundi [2]	68.0	18.2	-1.1	2.7	54	-0.2	1.9	-2.1	3.7
	Cameroon [2]	40.2	26.7	2.9	4.5	38	5.7	6.0	1.6	3.6
	Central African Republic [1]	81.5	25.9	1.6	-2.0	64	3.9	3.0	-1.2	-8.9
	Ethiopia [2]	44.2	25.6	4.3	3.6	38	1.9	0.9	6.4	5.4
	Ghana [2]	35.0	26.0	4.3	4.9	41	3.7	5.0	4.8	4.8
	Guinea-Bissau[5]	84.2	26.7	0.4	-1.2	59	3.1	3.3	-2.2	-6.4
	Mali [2]	63.8	34.0	5.0	6.3	35	2.8	5.1	6.5	7.0
	Niger [2,4]	74.5	31.5	2.8	4.1	40	3.2	5.1	2.6	3.4
	Nigeria [1]	67.6	36.4	2.9	5.4	36	3.8	5.3	2.5	5.5
	Rwanda [2]	60.3	25.6	2.7	5.2	44	4.7	4.7	1.3	5.6
	Tanzania[2]	35.7	19.3	4.0	6.8	42	3.6	4.9	4.3	8.3
	Togo [5]	63.3	28.8	3.1	2.6	37	3.2	2.7	3.1	2.5
	Uganda [2]	37.7	28.0	6.7	5.8	35	3.9	3.9	8.9	7.0
	SSA	44.0	22.3	2.9	3.9	32	3.4	3.6	2.8	4.0

* Data start dates are as follows: Senegal, 1991; Lesotho, Mauritania and Swaziland, 1992; Mozambique, 1993; Chad, 1994; Guinea, 1997.

1 Poverty figures from World Bank's Pov Cal (2006) and WDI (2006). The dollar a day poverty line is based on 1993 prices converted to Purchasing Power Parity (PPP).

2 National poverty rates are used, as they appeared to be more realistic than reported dollar a day rates. The 1990 rates range from 1990 to 1995 and 2001 rates range from 1996 to 2003. Source: Poverty Reduction Strategy Papers for various years.

3 Swaziland poverty elasticity is the average elasticity for landlocked countries, as there was no country-specific elasticity available.

4 National poverty rate shows an increase in poverty in Burkina, yet according to a World Bank publication of 2005, poverty rates have gone down in this country. For Malawi and Mozambique only one year is reported, and changes are estimated based on UNIDO or WB poverty estimates and others.

5 Dollar a day poverty rates from UNIDO (2004) are used as the only currently available poverty data source.

6 MDG Report values are for Africa-wide and are taken from Chen, Datt and Ravallion (2007)

7 Data for agricultural share in GDP for Chad and Niger are from 2003

8 Agriculture expenditure growth rates are calculated for the data available.

Table 3. Reaching MDG1 under different scenarios

Typology	Country/Region	More Conservative (Growth Rates for Agricultural and Non-agricultural, 1990-2004)	More Optimistic (Growth Rates for Agricultural and Non-agricultural, 2000-2004)	Six Percent Agricultural and Non-agricultural Growth from 1990 to 2004	Six Percent Agricultural and Non-agricultural Growth from 2000 to 2004
	Burkina Faso				Y
	Chad				
	Cote d'Ivoire				
	Gambia				
	Guinea				
	Kenya				
	Lesotho				
	Madagascar				
	Malawi				
	Mauritania				Y
	Mozambique	Y	Y	Y	Y
	Namibia				
	Senegal				
	Swaziland				
	Zambia				
	Zimbabwe				
Share of Ag GDP in total GDP>35 percent	Benin				
	Burundi				
	Cameroon	Y	Y	Y	Y
	Central African Republic				
	Ethiopia			Y	Y
	Ghana	Y	Y	Y	Y
	Guinea-Bissau				
	Mali				Y
	Niger				
	Nigeria				Y
	Rwanda				Y
	Tanzania				
	Togo				
	Uganda	Y	Y	Y	Y
	SSA				

Source: Based on author's calculations.
Y- indicates 'Yes, will achieve the MDG1,' and a blank cell indicates failure to achieve the MDG1.

Table 4. Government spending for agriculture in Africa

Typology	Country	Total Government Expenditure (international dollars, millions)	Agricultural Expenditure (international dollars, millions)	Agricultural Expenditure Share of Ag GDP	Agricultural Expenditure Share of Total Expenditure
		2004	*2004*	*2004*	*2004*
Share of Ag GDP in total GDP>10 percent<35 percent	Burkina Faso	3,162	493	1.6	15.6
	Chad	1,820	177	6.4	9.7
	Cote d'Ivoire	3,690	228	3.7	6.2
	Gambia	790	67	8.9	8.5
	Guinea	2,830	397	16.9	14
	Kenya	9,120	339	3.6	3.7
	Lesotho	2,010	159	26.5	7.9
	Madagascar	17,250	1,232	34.6	7.1
	Malawi	3,196	76	5.9	2.4
	Mauritania	1,810	100	11.2	5.5
	Mozambique	5,356	216	4.2	4.0
	Namibia	4,650	238	21.7	5.1
	Senegal	3,930	121	4.3	3.1
	Swaziland	1,650	38	8.3	2.3
	Zambia	2,491	72	4.1	2.9
	Zimbabwe	11,023	678	19.1	6.2
Share of Ag GDP in total GDP>35 percent	Benin	1,650	65	2.4	3.9
	Burundi	150	1.4	0.1	0.9
	Cameroon	5,800	223	1.4	3.9
	Central African Republic	520	14	0.6	2.7
	Ethiopia	23,520	1,996	5.2	8.5
	Ghana	15,340	127	0.8	0.8
	Guinea-Bissau	420	2.2	0.3	0.5
	Mali	2,590	435	9.0	16.8
	Niger	1,700	16	0.4	0.9
	Nigeria	48,142	1,415	4.1	2.9
	Rwanda	2,430	14	0.3	0.6
	Tanzania	1,860	42	0.5	2.3
	Togo	2,471	28	1.6	1.1
	Uganda	9,125	516	3.5	5.7
	SSA	190,494	9,789	4.6	5.1

Source: Government Finance Statistics (GFS) of the International Monetary Fund (IMF), supplemented by statistical appendix and PRSPs. The definition of agricultural expenditure is the standard definition used by the IMF in the GFS Manual, 2001.

Using the spending-growth elasticities, we estimate that in order to achieve the MDG1, the African countries will need to boost their agricultural spending to 33 to 39 billion 2000 international dollars annually from 2005 to 2015 (Table 5). This suggests that the region will need to increase its agricultural spending by 20 percent per year under the more optimistic scenario, or 24 percent under the more conservative scenario. Ethiopia, Ghana, Mozambique and Uganda can potentially reach the poverty reduction target by 2015 if they increase their investment in agricultural expenditure by up to 10 percent annually, but the majority of countries will have to scale up their spending substantially, by 20-30 percent per annum.

These results show the difference in magnitude between results obtained at the regional and country levels. The country-level estimates give an indication as to how the countries are performing with regard to achieving the MDG1, and the level of future resources that will be required to achieve the goal. It is beyond the scope of this paper to examine the different types of agricultural investment required at the country level. However, this work shows the dangers inherent in many of the poverty-reducing diagnostics that are currently being developed without accounting for the role of agriculture, the rural economy and its linkages.

Comparison with other reports reveals that our estimates of $33 to 39 billion needed to achieve the MDG1 are higher than the UNCTAD projection of $20 billion and lower than $54-62 billion projected by Devarajan et al. (2002). Both of the previous estimates are based on required growth rates, whereas our results are based on agricultural sector growth required for poverty reduction. In addition, we provide more detailed information at the country level.

Table 5. Agricultural growth and expenditure required to meet the MDG1

Typology	Country	Assumed Annual Non-Agricultural Growth Rates, 2004 - 2015 (percent)	Required Annual Agriculture Growth Rates to Achieve MDG1 (percent)	Required Agricultural Expenditure Growth Rates to Achieve MDG1 (percent)	Annual Agriculture Expenditure Required, 2004 - 2015 (international dollars, million)	Assumed Annual Non-Agricultural Growth Rates, 2004 - 2015 (percent)	Required Annual Agriculture Growth Rates to Achieve MDG1 (percent)	Required Agricultural Expenditure Growth Rates to Achieve MDG1 (percent)	Annual Agriculture Expenditure Required, 2004 - 2015, (international dollars, million)
		More Conservative Scenarios				*More Optimistic Scenario*			
Share of Ag GDP in total GDP>10 percent<35 percent	Burkina Faso	4.4	6.2	20.2	284	5.3	5.5	17.9	246
	Chad	4.3	9.9	32.0	1,356	6.0	8.1	26.4	953
	Cote d'Ivoire	2.0	10.2	33.2	1,768	4.0	8.9	28.9	1,344
	Gambia	3.3	8.9	29.0	426	5.3	7.2	23.5	301
	Guinea	3.9	8.2	26.7	3,621	4.0	7.4	24.1	3,068
	Kenya	2.2	11.3	36.7	4,318	4.0	10.0	32.5	3,313
	Lesotho	3.6	12.1	39.2	1,918	4.1	10.0	32.4	1,253
	Madagascar	2.4	10.9	35.5	*11,789*	4.0	10.2	33.0	*10,091*
	Malawi	1.7	10.4	33.8	1,175	4.0	6.8	22.0	556
	Mauritania	5.2	6.1	19.7	356	5.8	4.5	14.7	259
	Mozambique	6.0	3.6	11.6	463	6.0	3.0	9.7	413
	Namibia	4.1	10.1	32.7	1,912	5.1	8.1	26.1	1,262
	Senegal	3.9	8.6	27.9	714	5.5	6.6	21.5	478
	Swaziland	3.3	6.9	22.5	161	4.0	6.3	20.5	142
	Zambia	1.8	11.2	36.3	665	5.0	7.7	24.9	324
	Zimbabwe	1.1	18.0	58.6	*28,345*	4.0	15.5	50.5	*17,458*
Share of Ag GDP in total GDP>35 percent	Benin	4.4	8.5	26.7	356	4.0	7.6	24.0	301
	Burundi	1.2	10.9	34.1	12	4.0	10.5	32.9	11
	Cameroon	1.8	5.7	18.0	708	4.0	3.8	11.9	486
	Central African Republic	1.7	9.2	29.0	88	4.0	8.4	26.5	75
	Ethiopia	6.0	4.8	15.1	3,012	5.4	4.4	13.7	2,770
	Ghana	4.8	3.2	10.2	251	4.8	3.0	9.5	240
	Guinea-Bissau	2.4	10.3	32.4	17	4.0	10.2	32.0	17
	Mali	6.0	6.2	19.6	1,266	6.0	5.7	17.9	1,133
	Niger	2.7	10.5	33.0	131	4.0	10.0	31.5	5,154
	Nigeria	2.5	7.7	25.1	7,751	5.5	5.7	18.6	63
	Rwanda	4.4	7.6	24.0	268	5.6	8.1	25.6	307
	Tanzania	4.3	6.5	20.3	156	6.0	5.0	15.8	118
	Togo	3.1	9.6	30.2	312	4.0	9.1	28.6	281
	Uganda	6.0	3.5	11.1	954	6.0	3.2	10.0	891
	SSA	2.8	8.5	23.5	39,106	4.0	7.5	20.7	32,794

5. CONCLUSIONS

A significant body of literature notes the central role of agriculture in reducing poverty, especially in the African context. Despite this, none of the existing strategies for estimating the costs required to achieve the MDG include agricultural growth requirements or quantify the public resources needed to support this growth. Furthermore, the required growth and financial resources vary based on past progress in poverty reduction and the role of agriculture in the overall economy.

Several findings clearly emerge. First, in the 'business as usual' scenario, Africa will not be able to achieve the MDG1 at the regional level. At the country level, only a handful of countries will succeed, while the majority will fall short, indicating that the African countries need to accelerate their economic growth, particularly in the agricultural sector. At the regional level, an annual agricultural growth rate of 7.5 percent per annum is required. However, this masks a large variation among countries; Lesotho, Niger, Kenya, Madagascar, Guinea Bissau and Burundi will require at least 10 percent growth in agriculture, while Ghana, Mozambique and Uganda will achieve the goal if they continue at their present growth rates. Nigeria stands out as the only country with a high level of poverty that has the required agricultural growth rate close to 6 percent.

In order to achieve the MDG1, our analysis indicates that African governments will need to increase their agricultural spending by 20 percent per year. At the country level, this requirement ranges from achievable levels (e.g. Ghana, 9.5 percent) to far more difficult levels (e.g. Madagascar, 33 percent). The worsening situation in recent years in Zimbabwe leads to a required 50 percent annual growth rate in spending.

For Africa as a whole, the required investments are 32-39 billion per annum. These estimates are comparable to previous estimates at the regional level. However, our country-level estimates are significantly lower than those of other studies, thereby underlining the importance of agricultural growth in achieving the MDG1. While the aggregate totals are quite high, half the countries will require less than half a billion dollars per annum to achieve the goal. However, while it is vital to estimate the public resources needed to reach particular agricultural targets, it is equally important to prioritize investments. Limited evidence shows that investments in agricultural research and extension, rural infrastructure and rural education have the greatest impact on agricultural growth and poverty reduction (Fan, Zhang and Rao, 2004). However, as with the costing simulations, the particular context of each country will determine the investment priorities. The efficient use and targeting of these large public expenditures will require a complementary strengthening and reformation of governance and institutions.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1. Review of elasticity of growth with respect to poverty (Africa)

Country/Region	Elasticity	Years	Source
Elasticity of Poverty w.r.t. mean household expenditure			
Ghana	-0.99	1992-1998	Christiaensen, L., L. Demery, and S. Paternostro. 2002
Madagascar	-0.27	1993-1997	
Madagascar	-4.51	1997-1999	
Mauritania	-0.82	1987-1995	
Nigeria	-1.3	1992-1996	
Uganda	-1.21	1992-1997	
Zambia	-0.56	1991-1996	
Zambia	-0.35	1996-1998	
Zimbabwe	-1.23	1991-1996	
Tanzania	**-0.69**		TAKWIMU (Bureau of Statistics, Tanzania). 2000
Elasticity of Poverty w.r.t. GDP per capita			
Ghana	-1.19	Early 1990s to early 2000s	World Bank. 2005
Senegal	-0.95		
Uganda	-1.04		
Burkina Faso	-2.00		
	Baseline scenario at current trends	Agriculture-led and Non-Agriculture-led growth	Diao et al., 2007
Ethiopia	-1.10	-1.66 & -0.73	
Ghana	-1.49	-1.78 & -1.33	
Zambia	-0.35	-0.58 & -0.38	
Uganda	-0.98	-1.58 & -1.10	
Kenya	-0.67	-1.25 & -0.57	
Coastal Countries, Avg (-1.2)	Natural resources-rich Avg (-1)	Land-locked Avg (-0.7)	
Benin (-1.9)	Cameroon (-1.2)	Burkina Faso (-0.9)	
Cote d'Ivoire (-2.3)	Congo Rep (-1)	Burundi (-0.7)	
Gambia (-1.2)	Guinea (-0.7)	Central African Republic (-0.4)	
Ghana (-1.4)	Mauritania (-1.5)	Chad (-0.4)	
Guinea-Bissau (-0.3)	Namibia (-1.3)	Ethiopia (-0.4)	UNIDO, 2004
Kenya (-1.1)	Nigeria (-0.6)	Lesotho (-0.9)	
Madagascar (-1)	Zambia (-0.4)	Malawi (-1)	
Mozambique (-1.4)		Mali (-0.6)	
Senegal (-1.5)		Niger (-0.7)	
Tanzania (-0.6)		Uganda (-1.2)	
Togo (-0.8)		Zimbabwe (-0.7)	
SSA	-2.17	1990-1999	Mosley, P., J. Hudson, and A. Verschoor. 2004
Elasticity of Poverty w.r.t. Survey Mean Income			
SSA including South Africa and Nigeria	**-1.23**	1981-2001	Bhorat, H. 2005
SSA excluding South Africa and Nigeria	**-2.32**	1981-2001	

Table A.2. Review of elasticity of growth with respect to expenditures

Country/Region	Elasticity		Years	Source
43 Developing countries (including 17 African countries)	Elasticity of GDP growth w.r.t. govt agricultural spending	0.052	1980-1998	Fan, S. and N. Rao. 2003
	Elasticity of GDP growth w.r.t. govt education spending	-0.099		
	Elasticity of GDP growth w.r.t. govt health spending	0.211		
	Elasticity of GDP growth w.r.t. govt T&C spending	0.021		
	Elasticity of GDP growth w.r.t. govt defense spending	-0.182		
	Elasticity of GDP growth w.r.t. govt social security spending	0.007		
	Elasticity of Ag Output w.r.t. total govt expenditure on agriculture	0.037		
	Elasticity of Ag Output w.r.t. ag research expenditure	0.043		
South Africa	Elasticity of real GDP w.r.t. to real public investment	0.0157	1960-2001	Ashipala, J. and N. Haimbodi. 2003
	Elasticity of real GDP w.r.t. to real private investment	0.0392	1960-2001	
Namibia	Elasticity of real GDP w.r.t. to real public investment	0.1021	1980-2001	
	Elasticity of real GDP w.r.t. to real private investment	0.1279	1980-2001	
Botswana	Elasticity of real GDP w.r.t. to real public investment	0.0674	1970-2001	
	Elasticity of real GDP w.r.t. to real private investment	0.1534	1970-2001	
45 Developing countries (including 22 African countries)	Elasticity of GDP per capita w.r.t. government expenditure	-0.416	1980s, 1990s and 2000	Thirtle C, J. Piesse and L Lin. 2003.
98 developing countries	Elasticity of real Ag GDP with respect to ODA	0.03	1975-1985	Schuh, G. E., and G. W. Norton. 1991

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