Public Spending on Agriculture and Poverty in Eastern Cape Province, South Africa

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Abstract: Efforts to meet the Millennium Development Goal 1 (MDG1), which was to reduce by half the proportion of the population living below the poverty line by 2015, and the demands of democratization in South Africa have directed attention at the agricultural sector's potential for reducing poverty. Expectedly, agriculture has attracted considerable interest and public investment. This article explores the linkages between public spending in agriculture, agricultural growth, and poverty in the Eastern Cape Province of South Africa. The identification of the critical linkages will contribute to improving decision making on the use of public funds in agriculture. Methodologically, the study simulates the required agricultural investment and required agricultural growth rate that is sufficient to meet MDG1 by 2025 by employing partial equilibrium modeling based on the System Dynamics Analyses approach. This entailed the application of growth decomposition technique and growth elasticity of poverty concepts with a specific emphasis on policy interventions for promoting agricultural growth. The drivers and cause-effect relationships between agriculture and poverty reduction were investigated. The employed models allowed for an exploration of plausible future growth in public spending in agriculture, agricultural growth elasticity of poverty, and the possibility of reducing poverty levels in the province while evaluating strategies for meeting the MDG1 by 2025. Estimates for the required agricultural growth rate and the increase in public spending on agriculture required in order to reach MDG1 by 2025 were calculated for each district municipality in the Eastern Cape Province. All the district municipalities were then evaluated in terms of their need to increase public investment in agriculture and the ability to achieve MDG1 by 2025 and beyond. Estimates for both the required public spending and the required agricultural growth were then calculated following both the business-as-usual scenario and the best-case scenario.

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Introduction

Agriculture has since occupied the center stage in meeting the Millennium Development Goal 1 (MDG1) in many developing countries, which sought to reduce poverty worldwide by half by 2015.[1] Studies from six such countries strongly concur that rural economic growth and widespread poverty reduction require increased production in agriculture.[2] Multiple authors provide evidence that buttress this important linkage among agriculture, income growth, and poverty.[3] The agricultural sector has both a direct and an indirect impact on economic development.[4] In China, it was agricultural growth that enabled a significant reduction in poverty during the period 1978 to 1997.[5] The importance of the agricultural sector goes well beyond its direct impact on rural incomes as it has both upstream or backward linkages on the supply side and downstream or forward linkages on the manufacturing side.[6] The agricultural sector has a high degree of interrelatedness with the other sectors that emerges as a consequence of both the demand and supply effects of inputs and outputs.

South Africa has a dual agricultural economy, with both a well-developed commercial farming system and a more subsistence-based communal farming system.[7] South Africa's GDP data from agriculture averaged R57972.17 million from 1993 until 2016, reaching an all-time high of R77828.85 million in the fourth quarter of 2014 and a record low of R33530.55 million in the first quarter of 1993.[8] The agricultural sector represented less than 10 percent of the economy in 1960, and currently this figure is below 2.5 percent. However, the fact that the sector represents less than 2.5 percent of the economy does not provide the true picture of the sector's impact on the greater economy as this excludes the multiplier effects like buying inputs from the manufacturing sector, provision of raw materials for manufacturing and purchases a host of services.[9] The multiplier effect implies that each additional unit demanded from the agricultural sector has a strong effect on other sectors. Agriculture is an important source of inputs for other production activities and other industries/sectors, and the output of other industries is used in the form of inputs, which confirms the fact that agriculture's linkages with the rest of the economy are not only important but are usually underestimated. Calculations from national statistics show that primary agriculture has a backward linkage of 2.14 and a calculated forward linkage of the sector of 1.81. Despite the declining share in GDP, the South African agricultural sector continues to play an important role in the economy as it operates as a net exporter of agricultural commodities. South Africa maintained its status as a net exporter of agriculture, forestry, and fisheries products during 2013.[10] Agriculture has a direct bearing on income growth, poverty reduction, and overall economic growth. Continued investment in the sector will have a significant impact on a large number of households and the greater economy due to its employment and food security effects.[11] Growth in agriculture does not only benefit the rural communities; increased output in the rural areas has a direct bearing on the urban sector through its food price decreasing effect and creation of employment.

Economic growth in the former homelands of South Africa, where more than 70 percent of the population is regarded as poor and land is abundant, will definitely require significant improvements in agricultural production. Thus, there is need for studies analyzing the linkages between agriculture and agricultural growth and consequent reductions in poverty. With the objective of proposing a methodology for estimating the required investment to achieve any specified development target, this study presents an analysis of the linkages between public investment flows, agricultural growth, rural income

levels, and the level of poverty in Eastern Cape Province of South Africa. It examined the nature and dimensions of poverty in the province and how the two relate to public spending and the state of agriculture since the emergence of democratic South Africa in 1994. More specifically, this study aims:

a) To analyze and establish the influence of public investment in agricultural production in Eastern Cape;
b) To analyze the empirical relationship between agricultural growth and poverty in Eastern Cape Province;
c) To estimate the agricultural investment growth rate required to reach MDG 1 of reducing by half the level of 1990 poverty in Eastern Cape.

Measurement of the poverty level requires a standard definition to be applied overt time to properly determine trends. The depended variable in this study is the incidence of poverty. There are four approaches used in measuring poverty: the monetary approach, the capability approach, the social exclusion approach, and the participatory approach. The monetary approach is used to define poverty in this study. A poverty line is defined in terms of the monetary income sufficient for a person to attain a minimal standard of living. The World Bank estimate for the poverty line is $2 per person per day. In South Africa, the poverty line for households was set at R800 per month per household in the 1996 prices.[12] The same argument is retained in this study.

This paper is based on the premise that agricultural spending across Eastern Cape's district municipalities has the largest impact on agricultural production and poverty reduction. An assessment of expenditure need and fiscal capacity makes it possible to bring about equitable distribution of resources and have the highest impact on poverty. Since governments frequently face budget constraints, enquiries of this nature help them to quantify the required spending.[13] The findings of the analysis will rationalize the employed methodology by providing lessons regarding the level and composition of public spending that can be useful for poverty reduction and economic development.

It is every government's desire to have spending that produces the highest impact on GDP growth and poverty reduction. Populists advocate for increase in public spending, but simply increasing the level of spending is unsustainable as this will likely result in misallocation of government funds and inefficient spending.

Agriculture and Poverty Reduction

The slow rate of progress towards the reduction of poverty to levels stated by the MDGs in Africa is quite worrying. Thus, governments are facing substantial pressures to reduce poverty. One school of thought agrees without reservations that agricultural expenditure is the key driver of agricultural growth and poverty.[14] The other school of thought agrees, but with reservations. An argument was presented in literature that not all countries that allow their public spending to grow significantly score better quantitative results.[15] Public goods and services by the government will only impact positively on poverty if these goods reach the targeted poor populations.[16] Misallocation of these services often results in inefficiencies.[17] Table 1 below shows a meta-analysis that summarizes the relationship between public agricultural expenditure and its influence on agricultural GDP for various regions and country studies.

Table 1: Elasticity of Agricultural GDP and GDP Growth with Respect to Agricultural Expenditure

Study Countries	Value for Elasticity
Forty three (43) developing countries: Elasticity of agricultural GDP growth with respect to (w.r.t) government agricultural spending	0.05[18]
Forty three (43) Developing countries: Elasticity of agricultural Output w.r.t government agricultural spending	0.04[19]
South Africa's elasticity of real GDP w.r.t real public expenditure	0.016[20]
98 Developing countries: Elasticity of agricultural GDP w.r.t ODA	0.03[21]

Table 1 shows how agricultural GDP and national GDP response to changes in agricultural public expenditure components. The first two figures, 0.052 and 0.04 shows the elasticity of agricultural GDP with respect to government agricultural spending. A value of 0.05 implies that for each one rand spend on agricultural expenditure, 5 cents was returned. Changes in public agricultural expenditure positively impact agricultural GDP. The above figures for elasticity strengthen the development economists' theoretical understanding of the causal mechanisms underlying public agricultural expenditure and agricultural growth.[22]

Poverty decreases recorded in the modern history of England, India and China started with increased productivity amongst smallholder farmers.[23] A meta–analysis with illustrations of the relationship between agricultural growth and the incidence of poverty is presented in Table 2.

Table 2: Elasticity of Poverty with Respect to Agricultural GDP

Country	Value for Elasticity[24]
Ghana	1.78
Kenya	1.25
Uganda	1.58
Zambia	0.58
Ethiopia	1.66

Table 2 above shows agricultural growth's conduciveness to poverty reduction for five African countries. Negative elasticity larger than 1 are considered conducive to economic growth, a 1 percent increase in agricultural GDP leads to more than a 1 percent decrease in poverty, all other things being constant.[25] Thus a 1 percent increase in agricultural GDP in Ghana leads to 1.78 percent decrease in poverty, all other things being constant. Table 1 and Table 2 confirm a unidirectional relationship, where causality ran from government expenditures to agricultural GDP growth and agricultural GDP to poverty reduction. Increased agricultural production reduces poverty. It is increased agricultural production

that has allowed the poor countries to prosper. Almost none of the poor countries have achieved economic growth without first increasing agricultural production.[26]

Description of Eastern Cape Province

For the sake of this study it is important to present a review of the Eastern Cape Province, which is highly rural and essentially agrarian in nature. The province is richly endowed with farmland. Communal land tenure is mainly practiced in all the former homelands (Ciskei and Transkei). Households share some common village resources and using communal land, a similar situation to all the other rural areas in South Africa inhabited by black South Africans. Land is under the control of local and district authorities (headmen and tribal authorities) or residents allocated by means of "Permission to Occupy" (PTOs) certificates, which are approved by the headmen and the magistrates. As land and other resources in the rural areas are scarce, the size and the distribution of land and other productive assets among households are not the same. The climate varies according to the distance from the ocean. Coastal areas enjoy mild temperate conditions ranging between 14 and 23°C, while the inland areas experience slightly more extreme conditions with temperatures of 5 to 35°C. Inland mountain areas experience winter snows and summer rainfalls. The Eastern Cape is the only one of South Africa's nine provinces to have all seven of its biomes, or ecological zones and twenty-nine Acocks veld types within its boundaries.[27] This gives it a tremendous diversity of climates, allowing for a vast range of activities. The Eastern Cape has always been a livestock farming area. It is the country's premier livestock region and presents excellent opportunities for meat, leather, and wool processing. Table 3 shows the extent of poverty by district municipality for the Eastern Cape Province.

Table 3: Share of Population Below the Poverty Line Across Eastern Cape District Municipalities

	Year				
District municipality	1996 %	2000 %	2005 %	2010 %	2014 %
Eastern Cape	63.6	66.5	60.9	50.3	43.5
Nelson Mandela Bay	38.8	43.3	40.9	33.1	31.3
Cacadu DM	51.8	52.3	44.4	33.6	30.6
Amatole DM	73.0	75.2	67.4	54.6	44.9
Chris Hani DM	70.6	72.6	65.0	52.5	43.1
Ukhahlamba	71.1	72.8	64.5	51.8	43.0
O.R.Tambo DM	75.1	77.9	73.1	63.2	54.9
Alfred Nzo DM	78.0	81.3	75.7	66.8	57.5

Source: Eastern Cape's Socio-Economic Consultative Council (ECSECC) 2016.

Poverty is indeed widespread in the Eastern Cape Province as a whole. The district municipalities with the largest share of population living below poverty line in the province are Alfred Nzo and OR Tambo with 57.5 percent and 54.9 percent, respectively. It is worst in the former homelands where more than 50 percent of the population is classified as poor. When comparing poverty levels between 1996 and 2014, the recorded slight decreases in

poverty imply that the province's ability to meet the Millennium Development Goal (MDG) of halving poverty was in serious doubt.

In South Africa, a majority of the poor live in rural areas and derive income from both agricultural and non- agricultural activities, and strong linkages are always reported between agricultural growth and poverty reduction.[28] Thus, in South Africa, agricultural growth can have the same poverty reducing effect as that recorded in the Asian countries. Moreover, the magnitude of poverty in the former homelands, the number of people involved in agriculture and the millions of lives in rural areas confirms that transformation of rural South Africa requires nothing short of a radical change in the agricultural sector. In Africa, every 1 percent increase in per capita agricultural output led to a 1.61 percent increase in the incomes of the poorest 20 percent of the population.[29] The same results are achieved by asserting that the same increase can reduce the number of people living below the poverty line by 0.83 percent.[30]

Research Approach

There are various macroeconomic models and methodologies that have applications in the sphere of public investment, growth, and poverty reduction. For example, using time series data, the World Bank simulated the macroeconomic impact of public investment on GDP. More gains can be achieved by using similar macro-economic models to analyze and address misallocation of resources across and within subsectors. The research approach involved developing detailed econometric model for the agricultural sector for the Eastern Cape, including the collection and processing of historical economic data, and construction of substantial, partial equilibrium agricultural sector model. This modeling approach enables examination of complex, dynamic economic interrelationships at the industrial sector level, which enable simulations of the required resources to meet MDG1 by each district municipality in the Eastern Cape. Several studies find an important association among public agricultural expenditure, agricultural growth and poverty reduction.[31] Despite these revelations, this notion does not translate into budget allocations. In the light of this background, this paper presents a tentative methodology and the evidence that the agricultural sector contributes to and is a major determinant of economic growth and could reduce poverty.

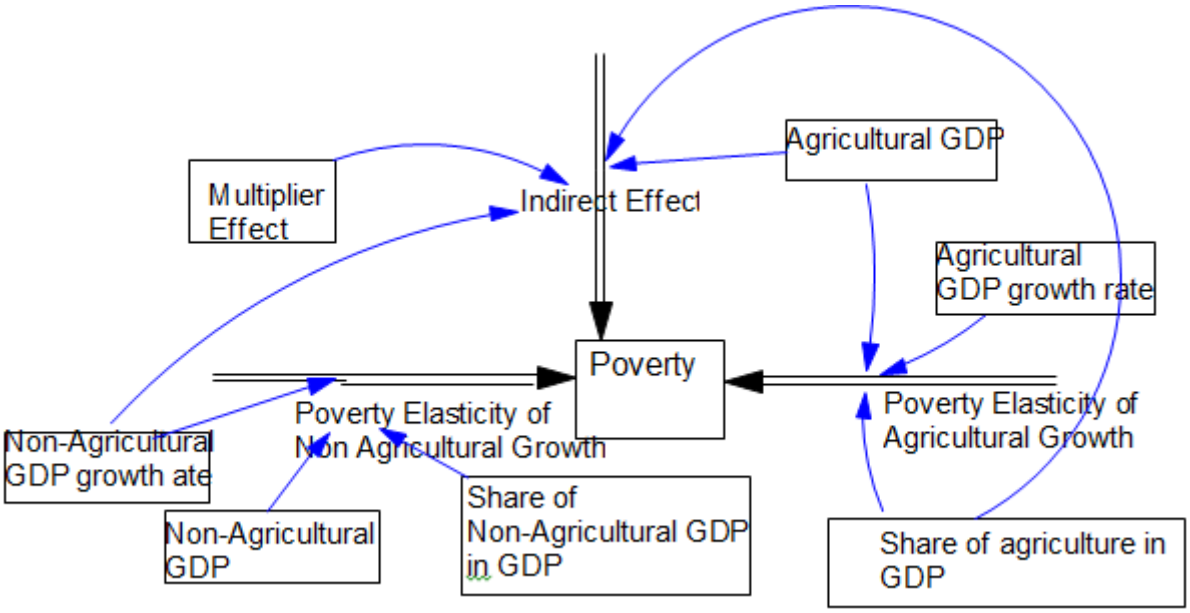
Model Description

The adopted methodological approach supports the linkages among government spending on agriculture, agricultural and non-agricultural income growth, and poverty reduction. It summarizes the main components and develops the set of models that draws simple relationships among the variables. Following these channels, this study is therefore designed around the conceptual principles relating to the two sources of income—agricultural income and non-agricultural income. Part of the framework was adapted from a policy brief. The marginal impact of agricultural and non-agricultural income on poverty can be presented by calculations of the equation that captures the elasticity of poverty reduction with respect to both agricultural and non-agricultural growth (see Appendix B: Equations (1) and (2)).

In order to capture the essence of the Eastern Cape's agricultural and non-agricultural sector on poverty reduction, a conceptual model linking poverty levels, agricultural income, non-agricultural incomes, and public expenditure was developed to capture their interdependencies. The mechanism at work is as follows: an increase in public agricultural investment causes an increase in agricultural output/GDP, which spills over to non-

agricultural output/GDP through a multiplier effect. These changes in agricultural and non-agricultural GDP increase incomes and reduce the poverty rate. A conceptual framework presented in Figure 1 captures the key elements of the framework.

Figure 1: Conceptual Model for Linkages between Agricultural, Non-agricultural GDP, and Poverty



Note: See Appendix A for variable explanation

Figure 1 presents the set of variables important when undertaking an analysis of the impact of agriculture and non-agricultural GDP on poverty reduction. This study is designed around the conceptual principles relating to the two sources of rural income growth or poverty reduction, namely agricultural income and non-agricultural income. Both agricultural and non-agricultural GDP reduces poverty. The arrows in the diagram above define the direction of the causal effect of a variable on another one. All the negative sign on the arrow implies a tendency in the linked variable move in the opposite direction with variable causing the effect and arrows without a sign implies a tendency in the linked variable to move in the same direction of the variable causing the effect. Part of the framework was adapted from similar research and some modifications were done so that the framework fits the current analysis.[32] In addition to the direct impact on poverty, both agricultural and non-agricultural growth directly creates farm or non-farm rural employment opportunities, thereby directly augmenting rural wages and incomes and thus indirectly reducing rural poverty. The diagram tracks the whole chain of causality between Agricultural GDP (G*ag*), Non-agricultural GDP (G*ng*), the indirect effects, and poverty rate. Key parameter values emerge as important: poverty elasticity of agricultural growth, poverty elasticity of non-agricultural growth, the elasticity of agricultural growth to public agricultural expenditure increase, and the multiplier connecting non-agricultural growth to agricultural growth. This framework prompts the analysis as it lays the basis for Equations 1 and 2 (Appendix B developed to estimate the relationships among the variables in this study). Any positive effect on the immediate macroeconomic determinants, namely G*ag*,

G*ng*, and the indirect effects are likely to cause a decrease in poverty.[33] Agriculture has economy-wide growth linkages. The importance of agriculture for overall growth on poverty is not only due to its large share of the rural economy but also because of its linkages to other sectors. For example, increasing maize production stimulates growth in the food-processing sector while also reducing food prices and increasing real incomes, which are then spent on non-agricultural commodities.

Costing Millennium Development Goal 1

Statistical simulations were employed to assess progress made towards achieving the MDG1 target using the time series indicators. Simulations were used on indicators to track changes in the performance of agriculture with respect to agricultural productivity and its role as a poverty and inequality reducing agent in the Eastern Cape Province. Exponential smoothing following the Hodrick-Prescott Filter was used to project whether the 2015 and 2025 estimate for the incidence of poverty as projected from past trends was enough to achieve the first MDG1 of cutting the poverty rate of 1995 by half by 2015. The Hodrick-Prescott Filter was used as an empirical technique to obtain smooth estimate of trend component of a series when you have only a few observations on which to base your forecast. This method is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. Using the available data, an attempt is made to extrapolate figures for the coming years. These figures are then used to assess whether the set targets for MDG1 are achievable or not. Figures for the base year (1995) and current status are compared to the estimates for 2015 and 2025 assuming a Business as Usual Scenario.

Each MDG requires an assessment of the range of interventions available and appropriate to meet the target and should provide a transparent framework for budgeting to meet the MDGs. It is therefore important to establish what increase in agricultural public investment would be needed to reduce the poverty rate sufficiently to meet MDG1. The adopted methodology and the series of derived equations in Appendix A seek to estimate what increase in agricultural public investment would be needed to reduce the poverty rate sufficiently to meet MDG1. Thus, the above string of causation is converted to rates of change, so the ultimate question becomes what changes in the agricultural expenditure growth rate will induce changes in the growth rate of output to meet MDG1. Three rates of change equations emerge from the string of causation namely: agricultural growth to GDP growth; GDP growth rates to change in poverty rates; and public agricultural expenditure to agricultural growth rate. They are quantified by Equations (3), (4) and (5) presented in Appendix B.

The simulations are done in reverse order for each district in the Eastern Cape Province. The rates of growth of agricultural output needed to reduce poverty rates to MDG1 levels by 2025 are calculated. Then, the rates of increase in agricultural public investment needed to achieve the required rates of growth in agricultural output are calculated. These simulated values are compared with business-as-usual rates that examine the consequences of continuing current trends in the economy.

Results and Discussion

The results presented in this paper summarize the trends in the incidence of poverty across all the seven district municipalities of the Eastern Cape Province and draw further attention to the distribution of the benefits of agricultural growth by tracing the response of agricultural GDP to public spending on agriculture, and how growth in agriculture

translates into poverty reduction over the years. Part of the results assesses the progress made by all the seven district municipalities towards the MDG1 and further estimates the required growth in public spending necessary to reach MDG1.

Progress towards MDG1

The results from Exponential Smoothing are shown in Appendix C. Appendix C, which present results of the Eastern Cape Province's progress towards MDG1, checking on whether this goal is achievable or not. Based on their past performance, results in Appendix C show the outcome of the results of the Exponential Smoothing for each district municipality.

Comparing figures for the base year (1995) and poverty level estimates for 2015 and 2025 assuming a Business as Usual Scenario, r all the district municipalities of the Eastern Cape Province are either off-track and slow or off-track and retrogressing as far as progress towards the MDG1 is concerned. Except for Nelson Mandela Metropolitan, all the district municipalities have been making progress, albeit slowly. The results of the estimates show that all seven districts would not reach the MDG1 target before 2015 and may not even by 2025. The situation is even worse in the case of Nelson Mandela Metropolitan. In that district, poverty is even increasing, implying retrogression and moving further away from the set target. The observed slow progress suggests that the global goal of halving poverty by 2015 was unattainable in the province.

Required Agricultural Growth Rate to Meet MDG1

The question addressed by this section is what is the estimated agricultural growth rate required to meet MDG1 in the Eastern Cape Province? Growth-poverty elasticity values are used to determine the extent to which poverty declines as agricultural production grows.[34] Data for missing variables was supplemented for by estimates from previous studies and explanations are provided for the choice of selected estimates. Table 3 provides the list of variables used and the estimated statistics for each variable.

Table 3: Variables Used in Costing Millennium Development Goal 1

District municipality	Required change in poverty for each year (%)	ε_{ag} = elasticity of poverty reduction with respect to (w.r.t.) agricultural GDP growth	g_{ag} = agricultural GDP growth rate	s_{ag}= share of agriculture in GDP	ε_{ng} = elasticity of poverty reduction w.r.t. non-agricultural GDP growth	s_{ng} = share of non-agriculture in GDP	g_{ng} = non-agricultural GDP growth rate
Amatole	5.52	-0.24	1.85	0.01	-0.07	0.97	0.04
Alfred Nzo	3.30	-0.26	2.93	0.03	-0.13	0.93	0.10
Cacadu	4.60	-0.41	0.55	0.11	-0.05	0.89	0.06
Chris Hani	3.10	-0.31	2.98	0.05	-0.003	0.95	0.05
Nelson Mandela Metropolitan	14.60	-0.13	6.94	0.004	-0.39	0.99	0.03
O R Tambo	11	-0.23	5.96	0.026	-0.37	0.97	0.08
UKhahlamba	4.03	-0.39	1.32	0.10	-0.012	0.90	0.08

Source: Authors' calculations based on data from ECSECC (2016) database and following the methodology.

Estimates of growth elasticity of poverty for all the seven district municipalities of the Eastern Cape Province are given in Table 3. It provides estimates of the elasticity between both agricultural GDP per capita and non-agricultural GDP per capita and the incidence of poverty in Eastern Cape for the period between 1995 and 2010. Using the Amatole district municipality as an example, the results suggest that for every one percent growth in agricultural production, as indicated by agricultural GDP change, the incidence of poverty falls by 0.28 percent. The estimated results on agricultural production show that the elasticity of the incidence of poverty with respect to agricultural GDP ranges from 0.12 to 0.41 and that for non-agricultural production ranges from 0.012 to 0.38. Non-agricultural production scored the lower of the two ranges given with an elasticity of 0.012. This figure is lower than 0.12 for agricultural production. The estimated coefficients of non-agricultural GDP per capita are significantly lower than that for agricultural GDP per capita for most district municipalities. It is, however, important to note that this does not necessarily imply that growth in agricultural GDP per capita was more important than growth in non-agricultural GDP per capita since the answer to that question also depends on actual rates of growth in the two variables over the study period.

Table 6.9 shows the breakdown thus obtained, revealing that for six out of seven district municipalities growth in agricultural GDP per capita was more important in reducing poverty, with only one district municipality shown to have reduced poverty mainly because of growth in non-agricultural GDP per capita. Notice that in some district municipalities such as Amatole, Cacadu, and UKhahlamba growth in non-agricultural GDP contributed very little to poverty reduction. The contribution for agricultural GDP growth was marginally high for all the district municipalities except for Amatole and Nelson Mandela Metropolitan.

Besides promoting agriculture, the overall reduction of poverty and the feasibility of the MDG1 and all the other goals in the Eastern Cape can be improved by undertaking a growth path that promotes both the agricultural and non-agricultural sectors. Therefore, in district municipalities where poverty reduction and the achievement of MDG1 prove unattainable through increased promotion of agriculture, non-agricultural activities could be promoted as they are assumed to contribute significantly to household incomes.[35]

Similar variables were used to estimate the amount of resources required to meet MDG1.[36] By adopting the same procedures, the methods employed here estimate the Required Annual Agriculture Growth Rates to Achieve MDG1 and the Required Agricultural Expenditure Growth Rates to Achieve MDG1 across all district municipalities of the Eastern Cape Province of South Africa. Estimates for the above variables were calculated from the Eastern Cape Province's data, Figures for both agricultural and non-agricultural elasticity of poverty were calculated using Equation (4) in Appendix A.

The value of the multiplier is very important as the results of studies of costing poverty reduction are sensitive to the choice of the multiplier and therefore proposed the use of values derived from systematic research. But municipal data on public expenditure on agriculture is scarce. In order to accommodate this, a careful review of the literature was undertaken to determine the most appropriate values for elasticity of agricultural growth with respect to public agricultural expenditure to be adapted for this study. In this study, the calculated values, the multiplier and expenditure elasticity, were considered flawed due to lack of appropriate data. The use of values from previous studies will make the results

comparable to previous outcomes. Further, the use of values from previous studies is relatively common in the literature on costing poverty reduction.[37] Table 4 shows the values for agricultural elasticity of public agricultural expenditure and the multiplier effect as founded in the literature, the respective authors, and the reason for adoption of those variables. The multiplier effect is assumed to be 1.5, which suggests that for each rand of gain in agricultural GDP, non-agricultural GDP rises by a factor of 1.5 in the same region. The multiplier effect has its greatest impact when idle resources exist. The figure for the multiplier is high, and this is based on the reasoned expectation that the Eastern Cape's agricultural economy is operating below national GDP as there are idle resources like land, labor and agricultural equipment. Therefore, for each spending round, idle resources are always available to be brought into production. The value for the multiplier was, however, supplemented with sensitivity analyses.

Table 4: Adapted Values for the Multiplier and Expenditure Elasticity of Growth

Variable	Elasticity Value	Reason
Multiplier effect	1.5	-Recent and comparable to other values from Africa -Founded using data from Africa
Expenditure Elasticity of Growth	0.32	

Source: Delgado et al. 1998; Fan and Rao 2003; Fan et al. 2008.

Following Equation 1 and the subsequent equation for poverty reduction due to non-agricultural growth, it is possible to calculate the value of the required agricultural growth rate. To estimate the agricultural growth rate required to meet the MDG1 in the Eastern Cape Province, we assume that growth rates will follow the business-as-usual trend. This scenario assumes that the economy follows similar growth as that observed during the period 1995 to 2010. The estimated figures for both the required annual agricultural growth rates to achieve MDG1 and the required agricultural expenditure growth rates needed to attain this growth rate are then calculated.

Table 5 shows the percent increase in public investment requirements based on growth-poverty elasticity methodology. All the district municipalities of the Eastern Cape Province will need to boost their annual agricultural growth to figures shown in Table 5, respectively, in order to achieve MDG1. The calculated values are higher than the observed municipal averages shown in column 2 of the same table. There is a huge gap between the required agricultural growth rate and the observed averages for the period 1995 to 2010. To reach this target, government agricultural spending will have to increase by the indicated percentage points for each respective multiplier value from (See Table 5) from an average of three percent per annum observed from 2000 to 2010. However, there is a large variation in required investment increases across the province's district municipalities.

Table 5: Annual Agricultural Growth Rate and Expenditure Required to Reach MDG1 by 2025

District municipality	Assumed Annual Non-Agricultural Growth Rates, 2004 – 2025 (percent)	Annual Agricultural growth rate since 1995 (percent)	Required Annual Agriculture Growth Rates to Achieve MDG1(percent)			Required Agricultural Expenditure Growth Rates to Achieve MDG1(percent)		
			Low Multiplier (0.5)	Medium Multiplier value (1.0)	High multiplier (1.5)	Low Multiplier (0.5)	Medium Multiplier value (1.0)	High Multiplier (1.5)
Amatole	0.04	2.04	14.27	13.11	12.14	44.58	40.98	37.92
Alfred Nzo	0.10	2.93	3.69	3.46	3.25	11.55	10.81	10.17
Cacadu	0.05	0.55	0.99	0.98	0.98	3.09	3.07	3.06
Chris Hani	0.05	2.98	2.06	2.06	2.06	6.44	6.43	6.42
Nelson Mandela Metropolitan	0.03	6.94	59.53	33.30	23.11	186.04	104.06	72.23
O R Tambo	0.08	5.96	14.20	11.58	9.78	44.38	36.20	30.56
UKhahlamba	0.04	1.32	1.00	1.00	1.00	3.12	3.12	3.12

Source: Authors' calculations based on data from the ECSECC 2016 database and following the methodology.

Presenting the exact current level of public spending and the required increases is more informative but because of data scarcity, results on the required increase in public finance for agriculture per municipality were presented in percentages only. Estimates indicate that in order to achieve MDG1, all the municipalities need to increase public spending on agriculture. Cacadu and Ukhahlamba have the least expected increase of 3 percent per annum. Nelson Mandela Metropolitan, OR Tambo, and Amatole have the highest required percentage increase in agricultural expenditure, in that order. Attainment of the required poverty levels in Nelson Mandela Metropolitan, OR Tambo, and Amatole can, however, be achieved by pursuing a pattern of spending that disproportionately favor spending in non-agricultural sector over agricultural sector. Almost all district municipalities need to increase their financial outlays in order to reach the MDG1 target. The inability of the Eastern Cape Province to reduce poverty substantially can largely be blamed on prescriptive spending that does not pay attention to the quality, analyses of trends, and impact of public spending on poverty.

Important findings emerge from the estimates found using the growth elasticity of poverty (GEP) estimates for Eastern Cape Province's district municipalities. Increased growth rate in agricultural production is paramount to reducing poverty in the province, and increased investment in agriculture is key to the achievement of this required growth. Computation of GEP has demonstrated that all the district municipalities of Eastern Cape need to boost their annual agricultural growth to 3.2 percent on average in order to achieve MDG1. To reach this target, government agricultural spending has to increase to an average of 10 percent per annum. However, there is a large variation in required investment increments across the Eastern Cape Province's district municipalities. These gaps between the 2010 level and the target poverty level can still be reduced by increasing public spending in line with the required increases and in all the cases this implies stepping up investment by a few percentage points (Table 5). Increases in agricultural spending should be guided by the calculated gaps in order to achieve MDG1.

Both the foregoing findings and reviewed literature advocate for increased public investment in agriculture and increased agricultural productivity for poverty to be reduced significantly. With regard to poverty reduction through increased public expenditure in agriculture, previous studies strongly recommended pro-poor growth path. The feasibility of attaining the MDG1 and all the other goals can be improved by a growth path that takes into account the nature of Eastern Cape's economy: abundant land, labor, and an agriculture based economy. Agriculture is a relatively labor intensive, low wage, and low skilled activity compared with manufacturing or services. It follows that increasing public investment in agriculture might increase output and hence employment of low-skilled, low-wage workers. And the beneficiaries are likely to be the populations below the poverty datum line—hence the result that poverty is more effectively relieved by expanding agricultural output relative to spending the funds in another sector of the economy which might have fewer (or no) workers living in poverty. Therefore, an effort should be made to promote policy intervention and increased public spending that contribute to pro-poor growth. Agricultural activities could be promoted in areas where poverty reduction and the achievement of MDG1 prove to be unattainable through increased public expenditure in agriculture. Similarly, non-agricultural activities could be promoted in Nelson Mandela Metropolitan Municipality since growth in the non-agricultural sector has a higher poverty reducing impact than growth in the agricultural sector in this municipality. Practising

agricultural and non-agricultural activities as sources of income have been considered essential in reducing poverty in the Eastern Cape Province.

The above findings propose that government needs to commit to a new, more radical course of action that clearly puts the agricultural sector at the forefront rather than maintaining the status quo in all the studied municipalities except for Nelson Mandela Metropolitan Municipality. Agricultural transformation requires fiscal policy adjustment on various aspects of public agricultural investment, including size of public spending, type of public spending, efficiency of public spending, and even investments in non-agricultural sector.

Our results illustrate the considerable utility of the partial equilibrium framework as a tool for estimating the required resources to meet specified poverty levels but with limitations. The model assumes some parameters from literature and adopts partial equilibrium analyses and ignores the general equilibrium effects that might however have a much clearer outcome. While agricultural development is prioritized in the province, analyses of other sectors allows us to explicitly recognize the beneficial impact of a dynamic poverty reduction system in the province without ignoring other important sectors. However, a quantitative assessment of this aspect is beyond the scope of this paper

Conclusion

The broad objective of the study was to evaluate the methodology that links public spending in agriculture and agricultural growth and agricultural growth and poverty reduction. Statistical methodologies can be used as powerful tools for decision making if coupled with the availability of appropriate data. Accurate and realistic policy frameworks for agriculture provide coherent plans government departments can use to evaluate progress towards MDG1. Estimates from the adapted model are close to reality and they rely on the reasonable expectation that intervention to meet MDG1 by provincial and national governments in poor economies is possible, as demonstrated by the string of causation in the Eastern Cape. This might be achieved through prioritization of spending. Investments in agricultural research and extension, rural infrastructure, and rural education have the greatest impact on agricultural growth and poverty reduction.[38] The progress is slow in the Eastern Cape Province, with the targets seemingly unachievable during the set timeframe. Although showing some significant strides towards the set target, the province is seemingly faltering in reducing poverty. Furthermore, the Eastern Cape Province would require increased investment in agriculture accompanied by robust and pro-poor growth well above historical rates.

While in theory a strong case for using complex methodologies for estimating the required public expenditure can be made, in practice the proposed methodology highlights significant difficulties in terms of availability of data and failure to exhaustively capture other growth spillover effects. This, however, does not imply that the proposed methodology should be completely abandoned. While trying to simplify the methodology, future research should involve developing a computable general equilibrium model that can consider the spillover effects of other sectors. Similarly, adopted parameters should be replaced by realistic and primary data acquired in the study area and will be supported by sensitivity analyses based on actual macro-economic indicators as employed by the statutory authorities such as Statistics South Africa and the Reserve Bank of South Africa.

Appendix A: Variable Description and Sources

Variable	Description	Data Sources
GDP constant 2005 prices	GDP is calculated using the output approach, the total value of goods and services, measured in constant prices, produced in a region with labour employed in that region.	National GDP data are compiled by the ECSECC and National and Various Provincial Departments.
Real Agricultural GDP Constant 2005 prices	Total value of agricultural goods and services, measured in constant prices, produced in a region with labour employed in that region.	Statistical Abstracts, ECSECC database
Non Agricultural GDP constant 2005 prices	The total market value of all non-agricultural goods and services, measured in constant prices, produced within the political boundaries of an economy during the year	ECSECC database
Incidence of poverty	The proportion of the population that lies beneath the official poverty line	ECSECC database
Public agricultural Expenditure	Spending by the government to pursue agricultural and rural development activities with the expectation of greater future benefits or rewards.	National treasury, National and Provincial Departments of agriculture and miscellaneous government publications
GDP growth rate	The percentage change in GDP from one year to the next. How much GDP grows over time.	STATS SA, Reserve Bank Data, World Bank
Share of agriculture in GDP	Share of agricultural GDP in total GDP	Authors' calculations based on data from ECSECC and various other sources
Share of non-agricultural GDP in total GDP	Share of non-agricultural GDP in total GDP	Authors' calculations based on data from ECSECC and various other sources

Appendix B: Multi-step GDP Costing Equations

The marginal impact of agricultural and non-agricultural incomes on poverty is assessed using the following equation:

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

Equation 1 captures the elasticity of poverty reduction with respect to both agricultural and non-agricultural growth. Where for each of the district municipality and the Eastern Cape Province,

P = the incidence of poverty

Y_{ag}= agricultural GDP

Y_{ng}= non-agricultural GDP

s_{ag}= share of agriculture in GDP

s_{ng}= share of non-agriculture in GDP.

$\dot{P}$ = 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.

Thus, Equation (1) can be rewritten as:

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

Strong growth linkages and multiplier effects of agricultural growth to the non-agricultural sectors have been identified by many researchers. These linkages and their effects on poverty levels are captured in Equation (2) above. The first and second coefficients capture the effect on poverty generated by both agricultural and non-agricultural growth respectively. The third coefficient captures the elasticity of poverty generated by multiplier effect due to growth in the agricultural sector. Partitioning the expected reduction in poverty among each of the terms in Equation (2) and solving for the required agricultural growth rate yields the following equation:

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

Where:

$\dot{P}_{ng}$ = the rate of poverty reduction emanating from a given non-agricultural growth rate, which is calculated from the second term in Equation (3), i.e.

$$\dot{P}_{ng} = \varepsilon_{ng} * g_{ng} * S_{ng} \text{----------(4)}$$

Equation (3) represents the agricultural growth rate that is required to reduce poverty annually from its direct effect. The level of public expenditure needed for agriculture to grow is calculated in Equation (5) and once the required agricultural growth rates are known, the corresponding annual changes in expenditure needed to achieve these growth rates can be calculated as:

$$\dot{E}_{ag} = g_{ag} / \delta_{ag} \quad \text{----------(5)}$$

Where:

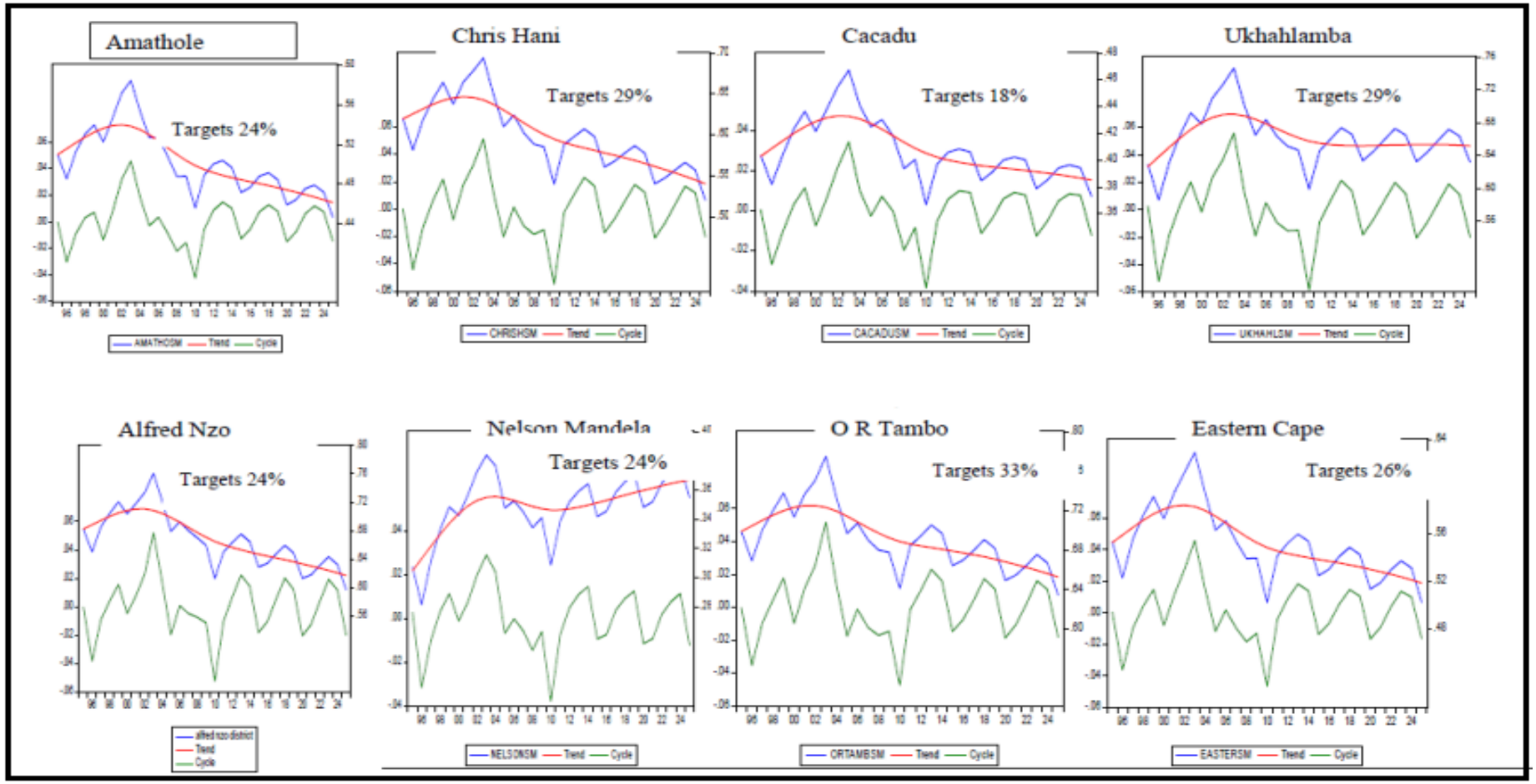
$\dot{E}_{ag}$ = the annual growth rate in agricultural expenditures, or

δ_{ag} = elasticity of agricultural growth w.r.t. agricultural expenditure growth which is calculated as:

$$\frac{dY_{ag}}{dE_{ag}} * \frac{E_{ag}}{Y_{ag}}.$$

The annual agricultural expenditure required between 2011 and 2025 can be easily calculated from the baseline data on actual agricultural expenditure in 2010 from Equation (5).[39]

Appendix C: Simulated Trend for the Incidence of Poverty until 2025



Appendix D: Variables Used in Costing MDG1

	$\dot{P}$	$\dot{P}_{ng}$	$\dot{P}-\dot{P}_{ng}$	$\varepsilon_{ag} * S_{ag}$	$(\varepsilon_{ng} * \phi_{ng,ag}) * s_{ng}$	$\{\varepsilon_{ag} * S_{ag} + (\varepsilon_{ng} * \phi_{ng,ag}) * s_{ng}\}$	g_{ag}	ε_{ag}	ε_{ng}	**Adopted multiplier** $\phi_{ng,ag}$	S_{ag}	g_{ng}	S_{ng}	$\dot{E}_{ag}$
Alfred Nzo	5.52	1.23	4.29	0.83	0.63	1.46	2.93	0.26	0.13	1.50	3.19	0.10	93.00	9.15
Cacadu	3.30	0.25	3.05	4.67	0.85	5.52	0.55	0.41	0.05	1.50	11.30	0.06	89.00	1.73
Chris Hani	4.60	0.01	4.59	1.52	0.02	1.54	2.98	0.31	0.00	1.50	4.85	0.05	95.00	9.33
Nelson Mandela Metropolitan	3.10	1.12	1.98	0.05	0.23	0.28	6.94	0.13	0.39	1.50	0.40	0.03	99.60	21.68
O R Tambo	14.60	2.80	11.80	0.59	1.39	1.98	5.96	0.23	0.36	1.50	2.60	0.08	97.00	18.63
UKhahlamba	5.71	0.08	5.63	4.06	0.19	4.25	1.32	0.39	0.01	1.50	10.33	0.08	90.00	4.14
Amatole	4.03	0.26	3.77	0.36	1.49	1.85	2.04	0.24	0.07	15.00	1.47	0.04	97.00	6.38

Source: Source: Authors' calculations based on data from ECSECC (2016) database and following the methodology presented

Notes

1 For details on the Millenium Development Goal 1, see http://www.un.org/millenniumgoals/poverty.shtml
2 Haggblade 2007 for Uganda; Govereh, Malawo, Lungu, Jayne, Chinyama and Chilonda 2009 for Zambia; Fan, Zhang, and Zhang 2002 for China; and Akroyd and Smith 2007.
3 Machethe 2004, Fan et al. 2002, Organisation for Economic Co-operation and Development 2006, and Van Zyl 2009.
4 Van Zyl 2009.
5 Fan et al. 2002.
6 Hirschman 1958 and 1977, Machethe 2002, and Van Zyl 2009.
7 Government Communications 2013.
8 Stats SA 2016.
9 Greyling 2012.
10 South Africa Government Communications 2012.
11 Greyling 2015.
12 Bhorat et al. 2004.
13 Fan et al. 2002.
14 Fan et al. 2002, Fan and Rao 2003, and Hall and Aliber, 2010.
15 Tanzi 2008.
16 Johnson 2001.
17 World Bank 2000; The Economist 2001.
18 Fan and Rao 2003.
19 Ibid.
20 Ashipala and Haimbodi 2003.
21 Thirtle, Hadley, and Townsend 1995.
22 Fao and Rao 2003.
23 Lipton 2005 and Mwape 2009.
24 Diao et al. 2007.
25 FFC 2011.
26 DFID 2005. Available online: http://www.dfid.gov.uk/pubs/ Accessed on the 25 of May 2009.
27 ECDC 2007.
28 Machethe 2004 and Ndhleve and Obi 2011.
29 Gallup, Radelet, and Warner 1997.
30 Thirtle et al. 2001.
31 Govereh et al. 2009 and Hall and Aliber 2010.
32 Fan et al. 2008
33 Bourguignon 2003 and Pasha and Palanivel 2004.
34 Fan and Rosegrant 2008 and Fan et al. 2004.
35 Non-agricultural activities have been considered essential in some parts of the province; see Ndhleve and Obi 2010.
36 Fan and Rosegrant 2008 and Fan et al. 2003 successfully estimated the amount of resources required to meet MDG1 in sub-Saharan Africa, Asia, and the Pacific.
37 Fan et al. 2008.

38 Fan, Zhang, and Rao 2004 argue that investments in agricultural research and extension, rural infrastructure and rural education have the greatest impact on agricultural growth and poverty reduction.
39 See Fan et al. 2008.

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