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Agricultural Science and Politics:

The Dynamics of Politically Motivated Funding for Agricultural R&D in sub-Saharan Africa

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List of Terms and Acronyms

Bt - *Bacillus thuringiensis* is a spore forming bacterium that produces crystals protein (cry proteins), which are toxic to many species of insects. A Bt crop is a genetically engineered variety of plant that is resistant to many pests.

CGIAR – Consultative Group on International Agricultural Research

DFID – Department for International Development

FAO – Food and Agriculture Organization

GE crop – Genetically engineered crop; synonymous with GM crop, transgenic crop or GMO

GM crop – Genetically engineered crop; synonymous with GE crop, GMO, and transgenic crop

GMO – Genetically Modified Organism; in the context of this paper, refers to genetically altered plants; synonymous with GE or transgenic crop

IBRD – International Bank for Reconstruction and Development

IFPRI – International Food Policy Research Institute

ISAAA – International Service for the Acquisition of Agri-Biotech Applications

Largeholder – farmers with large plots of arable land; often commercial farmers

NARS – National Agricultural Research Stations; government run agricultural R&D centers

NEPAD – The New Partnership for Africa’s Development

ODA – Overseas Development Assistance

Smallholder – farmers with small plots of arable land; often subsistence farmers

Transgenic crop – genetically engineered crop; synonymous with GM crop, GE crop or GMO

UN – United Nations

USAID – United States Agency for International Development

WFP – World Food Program

WHO – World Health Organization

Research Question and Abstract

What is the current state of agricultural research and development (R&D) in sub-Saharan Africa, how does it intertwine with politics, and why? How can roadblocks to agricultural science be overcome? This thesis addresses these questions, first by demonstrating the necessity of agriculture for nationwide development in sub-Saharan Africa, then by moving more specifically into agricultural research and development. Agricultural science is a critical yet underutilized tool in a Less Developed Country's (LDC) struggle to pull itself out of poverty and achieve nation-wide economic growth. Despite agricultural science and technology's proven track record of increasing smallholder yields and decreasing poverty in rural and urban alike, policymakers in sub-Saharan Africa often prefer spending scarce resources on themselves or on issues that are more significant politically. Until recently, agricultural research and development has received little attention from the press and from voters, making it relatively easy for politicians to overlook. In addition, the significant time lag between funding and results discourages policy makers from focusing on this sector: developing a new seed may take a number of years, whereas election cycles are comparatively short, making it irrational for a politician to spend money on a politically irrelevant sector, regardless of its positive effects in the long run. Fortunately, recent developments such as rising food prices have drawn more attention to the agriculture, and as a consequence, funding and production have increased.

Introduction

In a May 2008 interview, the director of the Food and Agriculture Organization's (FAO) Ethiopia office, Mafa Chipeta, delivered a stinging critique to his continent's governments: "Africa needs to be offended at the idea of a grown-up continent being fed by others that have no obligation to do so....African governments continue to demonstrate an unwillingness to pay for agricultural development and instead expect the World Food Program to send them assistance," (Hanson 2008). Harsh as his words may seem, the sentiment that African nations need to drastically increase efforts in the agricultural sector rings true. While much of the world enjoys access to public education, health care, food and clean water, the majority of sub-Saharan Africa remains mired in poverty. A barrage of statistics attests to this sad reality: 315 million Africans live on less than \$1 per day (IBRD 2008), a figure which has shown no signs of decline [see appendix A]; one-third of sub-Saharan Africans, or 265 million people, are chronically malnourished (FAO 2009); 13 nations on the continent have life expectancies that only reach into the 30s or 40s (CIA 2009). The agricultural sector, on which nearly two-thirds of Africans rely for their main source of income (Pardey, Alston and Piggot 2006), has been hit especially hard over the past few decades, with decreasing agricultural output per capita transforming these cash-strapped nations from net food exporters to net food importers (Ibid). To meet the

Millennium Development Goal targets (MDGs) for ending hunger by 2015, global agricultural production will need to increase by 40% (DFID 2008), and to keep pace with projected population growth through 2050, it must expand by 70% (IFPRI 2009). That is, to say the least, a tall order.

Agriculture as the First Step Toward Development

In order to reach these food production goals and consequently reduce hunger and poverty, agricultural development must be a major focus of national governments in sub-Saharan Africa; it is a necessary first step if these nations wish to achieve long-term food security and economic growth. Economists typically divide the economy into the agricultural, industrial, and service sectors, and it is this initial sector that serves as a foundation for the rest of the economy. A country incapable of feeding itself likely lacks the proper infrastructure, resources and competent governance to produce sufficient industrial or service goods. In the same way that England's agricultural growth was a prerequisite to the Industrial Revolution of the 1700s, that Japan underwent dramatic crop yield increases in the late 1800s prior to forming viable industrial and service sectors (IBRD 2008), and that a number of Asian states used the 1970s Green Revolution to spark nationwide economic growth, so too must Africa concentrate on agriculture as a starting point.

The link between agriculture and economic growth is easy to see: The Alliance for a Green Revolution in Africa (AGRA), an organization that promotes sustainable agricultural development for smallholders, notes that a 1% growth in agriculture produces a 1.5% growth across the economy (Perkins 2008:1). The Department for International Development (DFID) writes, "No country has ever achieved significant poverty reduction without first raising productivity in agriculture. Agriculture is not only the way the vast majority of Africans make their living but with its high multiplier effect across the wider economy, it is also the sector most capable of growing the continent's economy in the medium term" (2008:2). High rates of returns on investment in agriculture have been noted by volumes of social scientists. Steven Haggblade explains, "Broad-based poverty reduction in Africa will require significant improvements in agricultural performance. Only growing agricultural productivity can simultaneously reduce food prices, which govern real incomes and poverty in urban areas, and increase incomes of the majority of Africa's poor, who currently work in agriculture. For this reason, agricultural growth provides a central thrust around which the battle against African poverty must be waged" (2005:139). The high pay-offs of improving the agricultural sector cannot be denied.

Some economists, however, caution against too much optimism over agriculture's potential to ignite nationwide development in Africa. Despite the historical trend for agriculture to form the

basis of countrywide economic development, conditions in sub-Saharan Africa are different, many argue, and thus the same ‘path’ toward economic growth does not apply: “The initial conditions facing the currently poorest countries (and regions), precisely those by-passed by the first green revolution, are far more difficult than those facing the successful countries in East and Southeast Asia. The obvious question, but one without an obvious answer, is whether agricultural development is now simply too expensive, or too controversial, to pursue as the engine of pro-poor growth, even for those countries where the vast majority of the poor are farmers” (Timmer 2002:24). Thus it is far from universally accepted fact that agricultural growth will breed economy-wide growth. Still, while these economists provide valuable insight into agricultural growth factors specific to Africa, it is undeniable that increasing agricultural output among smallholders will reduce hunger, regardless of the debate over agriculture’s growth potential in sub-Saharan Africa.

Some LDCs have attempted to skip over the agricultural base and jump straight to industrial-based economies, a development tactic promoted by ‘Neo-Industrialist’ theorists (Ellis 1999). For politicians making political calculations, they are often tempted to create legislation aimed at the wealthier, more politically powerful citizens, which leaders may deem to be industrial development; because gains made in agriculture positively affect the poorest segments of the population to a greater degree than the wealthiest [see Appendix B], industrial rather than agricultural growth may be preferred. But the efforts of governments to emphasize industry first have fallen short, reinforcing the importance of agriculture as the first step toward economic growth. As Afif Tannous observes, “Some countries have already made the expensive mistake of trying to make a ‘big leap’ into industrialization, organized from above, depending heavily upon imported skills. [But] From the processing of agricultural products, through relatively simple complimentary industries, a country can move towards a more complex industrial system.” (1969:62). A solid foundation of agriculture and food security is a prerequisite for economic growth¹ – without it, a reduction in poverty cannot materialize. This is to say nothing of the positive effect agricultural production increases have upon alleviating hunger, whereas growth of industry, typically based in cities, would take much longer to reach rural poor (if it ever does). Despite his doubts over agriculture’s ability to spur growth in sub-Saharan Africa, even Timmer notes, “Efforts to “skip” the early stages and jump directly to a modern industrial economy have generally been a disaster” (2002:7). Unfortunately, most governments in sub-Saharan Africa have spent insufficient resources upon this sector: as Jacques Diouf, director-general of the FAO laments, ““In the fight against hunger, the focus should be on increasing food production. It’s

¹ There are two notable exceptions to this rule. Hong Kong and Singapore achieved significant economic growth without agriculture, though this can be attributed to the vast amount of resources Great Britain poured in to build up these Asian port cities. After Great Britain left these city-states to self rule, the territories had received sufficient infrastructural and educational support to focus on the service sector of the economy without promoting agriculture first.

common sense that agriculture would be given the priority, but the opposite has happened” (David 2009). In spite of the sector’s enormous potential, agriculture remains a relatively untapped source of economic power for sub-Saharan Africa.

Agricultural Research & Development Basics

Short, Medium, and Long Term Solutions to Hunger

If it can be safely concluded that a strong agricultural sector is a prerequisite for nations in sub-Saharan Africa to improve the economy and reduce hunger, governments must next decide which strategies work best to increase yields. When working towards food security for an entire nation, these administrations must account for short term, medium term, and long term procurement. States seeking short term fixes often resort to food aid when faced with an impending crisis, preventing starvation in the immediate future but doing nothing to ensure future nourishment. Still, food aid saves lives in famine-prone countries despite the short-lived benefits. Medium term food security strategies target upcoming harvests and often include input subsidies for farmers, so that the prices of fertilizers and/or seeds are low enough to allow small-scale farmers to purchase them and consequently improve productivity. Such governmental policies have produced favorable results: Malawi, for example, went from net food importer to net food exporter in a remarkably short period of time following the distribution of fertilizer subsidies (IFPRI 2009). While input subsidies produce excellent results for the following harvest, they must be renewed every year to continue making an impact. If a new administration decides subsidies are no longer politically expedient, it may cut funding. Finally, long term food security plans offer sustainable solutions to improving agriculture; these strategies include distributing technologies created during agricultural research and development. Scientists and agriculturalists work to develop new farming methods and technologies that can increase yields, both in quantity and quality. The Green Revolution in Asia is a prime example of using agricultural science (in this case higher yield rice varieties) to spur countrywide development.

There are many sub-sectors within agriculture that deserve the attention of policy makers, such as input subsidies, extension programs, market improvements, credit schemes, and more. One critical ingredient of agricultural growth is research and development (R&D), which uses science to discover new methods of increasing food production, whether by creating a drought-tolerant (DT) seed, an insect resistant plant, or a healthier breed of livestock. Kassa defines agricultural R&D as “A purposeful, controlled, systematic, critical and intensive activity whose objective is to generate or adapt technically and financially feasible, ecologically sound, and easily adaptable technologies that are critical components in the process of developing agriculture” (1996:165). Agricultural science plays a crucial role in the *long-term* improvement of the agricultural sector –

food increases are not instantaneous - which in turn plays a crucial role in the development of a nation's economy as a whole; from this it can be concluded that agricultural science plays an important role in the development of a national economy, and thus ultimately helps alleviate poverty. The Department for International Development writes, "Rates of return of 40 – 80 % are typical for high quality agricultural research. A ten-year evaluation of the Consultative Group on International Development research showed that for every \$1 invested \$9 were returned in benefits to poor communities," (2008:26). Such enormous rates of return mean the potential to alleviate poverty through agricultural research and development is vast.

Evidence from researchers support this train of logic: "A recent analysis by the International Food Policy Research Institute demonstrated that investment in agricultural research has a larger impact on poverty compared to investments in infrastructure and health in a number of countries studied" (DFID 2008:3). Thirtle and Townsend carried out several studies tracking the relationship between expenditures in agricultural R&D and poverty reduction, and conclude, "Our findings make a strong case for increasing public expenditure on research in South African agriculture. Not only are the returns to expenditure on research relatively high, but the poor benefit relatively more than the rich from such expenditures" (2000:201). Even more fieldwork by social scientists bolsters this claim: "Karanja (1990) found that increases in research expenditures and the spread of hybrid seed explain the improvements in maize yield and the expansion of maize area. After adjustments, he showed that a 1% increase in research expenditure...translated into an annual rate of return (ROR) of 68% in value terms. An ROR of 68% is excellent compared to alternative investments" (Ndiritu et al 2004:113). There is a strong connection between agricultural R&D expenditures and the accompanying increase in yields, and consequently drops in local hunger or increases in cash from the crops sold.

Of course, it should be kept in mind that agricultural R&D is most effective as part of a package deal. Governments must address a host of accompanying issues for R&D to be as successful as it can, including increased use of fertilizers, water/irrigation, market access, infrastructure, credit, and extension services/farmer education. All are critical ingredients to sustained agricultural growth. As Ndiritu, Lynam and Mbabu write, "Agricultural research is critical in increasing agricultural productivity. Yet it is only one piece of an interlocking chain of drivers of agricultural development," (2004:43). Nevertheless, agricultural science has proven to be a vital ingredient in agricultural development and hunger alleviation alike.

Who pays?

Many institutions are involved in agricultural science: national government research centers (NARS), internationally-run and funded research centers like those managed by Consultative Group on International Agricultural Research (CGIAR), universities, private companies like Monsanto from the US looking to make a profit by creating marketable technologies, and

producers of a certain crop that band together to pay for private research for their product. Funding sources for these organizations vary. NARS are supported by taxpayer money. International Research centers are typically funded by wealthy governments and donors alike, while universities enjoy a mix of public and private funding. Private companies and interest group research are, of course, privately funded (Paarlberg 2008). The majority of research and development in poor nations – especially research aimed at improving subsistence crops and livestock – is government-funded (whereas the majority of R&D worldwide is privately funded and generated in wealthy countries) [see appendix C]. Liebenberg and Kirsten write, “Public sector finance still remains the most important source of agricultural R&D funding in Africa,” (2003:211). Haggeblade agrees: “Publically funded research has proven responsible for the bulk of new technology development in the cases we studied (2005:149). While all of these institutions provide valuable agricultural science, NARS represent the most important contribution to subsistence farmers in sub-Saharan Africa; for the purposes of this thesis, I will focus upon government-funded rather than privately funded research and development.

Unfortunately, sustained agricultural R&D investments by governments in sub-Saharan Africa have been virtually non-existent. While emerging powerhouses China and India have tripled funding for agricultural science over the past 20 years (IBRD 2008), and investment rose an average of 30% in the developing world as a whole, national government expenditure in sub-Saharan Africa dropped by 27% between 1981 and 2000 (Hanson 2008). Pardey et al note that “...research is underfunded and current government investment inadequate” (2006:12). National underinvestment has been compounded by a sharp decrease in international aid flows earmarked for agricultural science: “Overall, agricultural Overseas Development Assistance (ODA) to poor countries from rich fell from \$5.3 billion in 1980 to \$1.9 billion in 2003. African governments were unable to make up for this tremendous fall, so in about half of the recipient countries agricultural research spending stopped increasing and went into decline” (Paarlberg 2008:95). Though a few triumphs have arisen out of this struggling sector, sub-Saharan governments have not put up a *sustained* push to ensure that the total package of ingredients necessary for these scientific discoveries to be successful are adequately implemented to the point that they make nationwide, noticeable impacts on poverty reduction (Djurfeldt et al 2005). Why has an investment that shows such promise been ignored?

Politics and Time Lags

Because of politics. Agricultural science, which may not achieve its full benefits for years after the initial investment is made, is hardly an attention grabbing topic. When compared to the host of ills sub-Saharan governments face - acute starvation, crumbling urban infrastructures, instability and the threat of rivals taking power, the twin plagues of malaria and HIV, drought, weak economies, corruption - agriculture seems quite dull. Democratically-elected governments in impoverished nations prefer to spend their scant resources on programs that produce rapid

results, so that voters see the effects of the policies before the politicians come up for re-election. In the same vein, even autocratic regimes prefer to enact policies popular with the general population so as to avoid discontent that could lead to revolts (Shepherd 1975). Like everything funded by the government, agricultural science is part of a political chessboard:

“It must always be borne in mind that instruments and plans for development never exist in an abstract world, but in a political world....The non-scientific, political world has its own rationale, however maddening to the ‘pure’ scientific mind: before planners can plan, developers develop, and administrators administer, rulers must rule. **Long-term scientific rationality must – will – yield to short term political rationality** necessary for any future, at least any future acceptable to the ruler,” (Waldo 1969:395).

From the perspective of politicians, science must take a back seat to political exigencies. Political cycles are short compared with agriculture science cycles, creating a disjuncture between the two worlds. Sadly for agricultural R&D, the benefits take a long time to realize: “It typically takes seven to ten years of breeding to develop a uniform, stable, and superior crop variety....This burden [money invested] is felt immediately, whereas the payoff it promises may take a long time to come out and will be much less perceptible when it does,” (Pardey, Alston and Piggot 2006:15). It is illogical for an official to spend money on agricultural research that won’t provide extra crop yields for another decade if his next election comes in 3 years, a concept which will be explored in depth later. As a result, the little money that is spent on agriculture focuses more on short and medium term solutions, such as emergency food aid or input subsidies. Though citizens may benefit more from research and development funding in the long run, the improvements may take several years to realize, and thus will not provide a political benefit to the politician who put them in place. In this way, the potential for huge gains in the long term are often exchanged for moderate or even marginal gains in the medium or short-run. As FAO economist David Dawe explains, “‘Agriculture may look ‘less sexy’ because of its slower growth rate, but still needs sustained investment to feed people in developing countries’” (David 2009).

Thus, funding (or lack thereof) for agricultural research and development is based upon local and international political considerations rather than the needs of a hungry and impoverished populace. Paarlberg writes, “Africa lags in farm productivity not because science has failed, but because Africa’s political leaders have largely failed to invest in science,” (2008:10). Fortunately, recent increased attention on agriculture has forced policymakers in sub-Saharan Africa to take a new look at this underappreciated sector; though much of the 1990s and early 2000s saw a precipitous decline in agricultural science and technology investments, a number of governments have, of late, increased investment into this critical area in hopes of spurring countrywide development. Such increases are invaluable. Jumps in funding give observers reason to be optimistic about the future of agricultural growth – and consequently poverty reduction – in Africa.

Theoretical Structure

Several theories can account for the politically-minded steering of agricultural research and development in national governments. Political philosophers as far back as Thomas Hobbes, who wrote his masterpiece *The Leviathan* in 1660, and as recent as Robert Holcombe, who is still writing today, have crafted theories relevant to this topic; apparently, the nature of mankind is not much altered over the past 400 years. In any event, Decision Making theory, which is an offshoot of rational choice theory, and Pluralism are the two primary philosophies dealt with in this thesis. First, I will explicate the ideas of Thomas Hobbes, whose analysis of the role of government provides a solid foundation upon which Decision Making and Pluralism² stand.

Hobbes' Leviathan

Few prominent authors reflect a more pessimistic view of mankind - and in turn of government, which is comprised of men - than Seventeenth Century political philosopher Thomas Hobbes. Each individual is out to secure safety and sustenance for himself, he posits in his work *The Leviathan*, and holds little interest in the needs of others unless it somehow influences his own life. Though people may be at peace when there is plenty to go around, when resources are limited war will break out, as self-preservation overtakes any generous instincts (Hobbes 1660). Since we have unlimited desires but limited resources, competition between self-interested humans inevitably arises when two people realize there is scarcity, or only enough property for one to enjoy: "Competition of riches, honor, command, or other power, inclineth to contention, enmity, and war; because the way of one competitor to the attaining of his desire is to kill, subdue, supplant, or repel the other" (Hobbes 1660:58). Humans are naturally bellicose.

Perhaps this view is extreme, and when looking at the whole of humanity, our kinder traits must be taken into consideration. Yet governments, at large, behave in the way that Hobbes describes individuals. Each is looking to preserve itself; when there are limited resources, states fight one another, which is a common precept in international relations (Viotti and Kauppi 2001).

In the domestic sphere, a government will seek to preserve itself by doling out goods and services in accordance with distribution systems that will keep it in power. Robert Bates writes, "Holders of public office fully realize that in order to remain in power, they must manipulate the bureaucracy of the state to secure such benefits. The result is a general tendency to orchestrate public programs to secure political advantage. And...the tendency is particularly strong with respect to agricultural programs," (1981:113). Consequently, when people are starving, but agricultural R&D is not trendy and avoiding it will not threaten a government's power, rulers will not focus upon it. But when it is rising in popularity, their attention will turn toward this sector, as can be seen today. Bates continues, "Agricultural policy is derivative. It is devised to cope with political problems whose immediate origins lie outside of the agricultural sector," (1981:35). This brings us to Decision Making Theory.

² The author is aware that Hobbes is more traditionally associated with Realism than Pluralism, but believes it is an appropriate fit in this case; the explanation will be provided shortly when I proceed to the sub-section on Pluralism.

Decision Making/Rational Choice Theory

Decision Making theory asserts that government and politics can be treated as a series of decisions taken by persons and institutions who make rational decisions, or who act as if they made rational decisions, in the light of their interests and the circumstances in which they operate (Dunleavy 1991). On the level of an individual actor, this is commonly known as Rational Choice Theory (Hall 2009). Heavily influenced by the writings of Max Weber, Decision Making relates that once a government knows what is in its own best interest, it will seek to follow policies that ensure reaching this goal; it makes “the assumption that the social actor, whether the individual or a collectivity, seeks to optimize rational gains within the limits of the objective situation in which the actor finds him, her, or itself” (Delanty and Strydom 2003:372).

Of course, this leaves open the possibility that just because an actor seeks to maximize its own version of what it considers ‘good’, it will be incorrect in its calculation. We do not always know what is best for us. Jon Elster, a well-known proponent of rational choice, writes, “I have insisted on the subjective nature of rationality” (2001:450), and goes on to explain that rational choice does not mean people literally weight costs and benefits on a scale, then select the appropriate course of action (Elster 2001); rational choice merely asserts that however misinformed, however shortsighted or driven by emotion underneath, people and governments act in order to maximize what they take as their own good. The treatment of Genetically Modified Organisms (GMOs) in Africa provides an excellent example of Elster’s claim, which will be discussed later on.

In the case of agricultural R&D, governments in sub-Saharan Africa heartily confirm the relevance of Decision Making theory. Funding is not granted for programs that will have the most positive impact on increasing yields or reducing hunger, but instead on those that will either a) ensure retention of power, or b) increase the leaders’ or leaders’ families/clans personal wealth. Henry Bienen notes, “Domestic political exigencies largely explain the intervention of states in African agriculture....Politicians and administrators are assumed to have acted rationally by their lights, just as analysts have come to consider peasants as rational actors trying to maximize income and security. Politicians usually want to maximize their power or at least their chances of remaining in office. They also want to increase their status and income,” (1987:297). This behavior is not unique to African governments. It can be seen clearly in the actions of many Asian administrations at the outset of the Green Revolution; fortunately for hungry Asians, these governments made the opposite calculation: they could not afford *not* to increase food production, and as such, decided to concentrate on new agricultural technologies. Larsson, Holmén and Hammarskjöld write, “Recurrent famines and food shortages and a high dependence on imports, together with often precarious geopolitical situations, created a sense among Asian political elite of national vulnerability that fitted badly with the new nations’ ambitions to form their own destiny. Achieving self-sufficiency in food was thus given the

highest national priority,” (2002:18). In the end, governments decide their courses of action based upon retention of power. If helping the poor is a means to this end, all the better for the people of the country; if not, the poor likely remain invisible.

Pluralism

Conventional wisdom places such a pessimistic view of individual and group behavior close to realism, which emphasizes the power struggle over resources. This may seem a perfect fit with Decision Making theory, and I do not wish to dispute realism’s validity; however, realism does not do justice to the multiplicity of actors involved in the decision making process at the state level. Though realism and pluralism are treated as opposing theories, oftentimes aspects of each prove suitable to the same situation. In the case of agriculture in sub-Saharan Africa, the number of actors involved demands the inclusion of pluralism. Pluralism is defined as “an image of politics that emphasizes the multiplicity of actors, challenging the realist preoccupation with the state as a unitary actor,” (Viotti and Kauppi 2001:23). Paul Johnson is more explicit in his description, saying,

“Pluralism is best understood through the generalization that power is relatively broadly (though unequally) distributed among many more or less organized interest groups in society that compete with one another to control public policy, with some groups tending to dominate in one or two issue areas or arenas of struggle while other groups and interests tend to dominate in other issue areas or arenas of struggle. There is no single, unified “power elite”, but rather there are many competing power elites with differing backgrounds, values and bases of support in the broader society” (2005:1).

Certainly, some states are more ‘pluralist’ than others. Dictatorships may be driven by as few as one individual’s desires, whereas well-functioning democracies take many voices into consideration. The current political situation in sub-Saharan Africa falls somewhere in between: while there are elite segments of the population that dominate the government, the fact remains that there is very real competition in these nations for resources, not only between ethnic tribes but between competing economic interest groups. While realism and Decision Making theory accurately describe much of what happens in this region – the government ultimately acts as a unitary actor – the addition of pluralism presents a more complete picture by taking into account the various opinions that are weighed when making decisions. Strict realism does not allow for enough complexities in the policy making process.

The colonial history of Africa weighs heavily here. Because many rival ethnic groups were thrown together under a common government by European powers upon decolonization, ‘neopatrimonial’ states evolved, in which weak and corrupt governments distributed scarce resources to their tribesmen rather than to whichever citizen needed it the most (Kohli 2004). Describing the situation in post-independence Nigeria, Kohli writes, “The key ingredients of this state were a fragmented and contentious polity with little commitment on the part of leaders to

national development...and broader political tendencies of regionalism and patronage politics. Power sharing in the central government and sharing related resources were the main sources of conflicts...These differences made for varied policy preferences in what was otherwise a fairly naked ethnic struggle over power and resources,” (2004:332). Unfortunately, Nigeria’s struggles are mirrored in a number of sub-Saharan states. If one leader gets a position of power, he will likely share the boon with his own clansmen rather than someone from an ‘enemy’ tribe, even if this other individual is his countryman. This phenomenon is predicted by the aptly named ‘Exclusion Theory’ (Parkin 1979). Kenya’s current state of affairs is a testament to this trend: President Mwai Kibaki and Prime Minister Raila Odinga, leaders from antagonistic tribes, are today locked in a battle over whether to fire the questionably corrupt Minister of Agriculture (McKenzie and Karimi 2010). As the Minister of Agriculture is from Kibaki’s ethnic group, Kibaki supports him; needless to say, Odinga wants the Minister fired. The agricultural department is here used as a pawn to play out ethnic tensions rather than for its intended purpose of improving food security and boosting the economy.

It is not only ethnic divisions that create a political environment full of competing interests. Small-scale subsistence farmers often have different wants and needs than large-scale commercial farmers. Even more pronounced is the divide between the wants of urban and rural inhabitants. Michael Lipton explains urban bias mechanisms, which pervade almost all sectors of African governments: “Rural people, while much more numerous than urban people, are also much more dispersed, poor, inarticulate and unorganized...On the whole, rural groups fight each other locally; nationally, they seek to join or to use urban power and income, not to seize that power and income for the rural sector: (1977:66). Urban consumers desire low food prices, rural producers prefer high prices, and the African governments have been known to intervene and set their own preferred prices (Djurfeldt et al 2005). More often than not, the government sets low prices to appease the urban population, a politically important constituency, leaving their relatively powerless rural counterparts to endure smaller profits. Perhaps even more overlooked than rural dwellers as a whole are the landless rural laborers, who not only fail to benefit from the urban biased policies, but likewise have little to gain from policies that positively affect smallholders. Here pluralism accurately describes the process of government: a number of groups compete to influence the national policy. In the agricultural sector, these competing interests must be taken into account, and not everyone will be satisfied with the final policy: “The transition to agricultural policy that embraces this vision [to increase subsistence crop agricultural research and development] will require careful management of the political aspects. There are numerous actors involved in the agricultural sector, all with some vested interest in the process and its outcome. Some will be winners and some will be worse off,” (Thirtle, Townsend, van Zyl, and Vink 2000:304). Hence, it appears that pluralism is also an appropriate theory for analyzing the politics of agricultural research and development.

Methodology

This thesis relies upon literature review to answer the research questions, “What is the current state of agricultural research and development in sub-Saharan Africa, why has it evolved in such a way, how does it interact with politics? Furthermore, what can be done to improve this sector?” Much has been written on the subject by well-respected experts in a number of fields, with authors ranging from economists, to agriculturalists, political scientists, biologists, and so on, making it an appropriate method for the interdisciplinary topic at hand. While fieldwork is well-suited for many social science research projects, it did not fit the needs of this thesis.

I began this project with the aim of writing an intensive case study, thinking that I would research a single country or a few countries in sub-Saharan Africa and determine how their policies promoted or discouraged agricultural R&D, and what prescriptive measures they should take. However, as my research progressed, a clear pattern emerged throughout the sub-Saharan region: there was a near universal neglect for agricultural science following decolonization, with newly born governments focusing on accruing power rather than pushing development forward. Upon further investigation, the underlying political structures were quite similar as competing ethnic groups and other interest groups vied for political influence; while this is not to claim there was no diversity in African politics at the time, much of the continent followed similar patterns. The spotty relationship between politics and agricultural research and development likewise emerged again and again in my studies, further emphasizing the need for continent wide research rather than a single case study. I am not claiming that sub-Saharan Africa is homogenous in terms of agricultural science – far from it – but a similar relationship between politics and R&D has emerged throughout the region.

Literature Review

A literature review consists of compiling information from various sources that can help address the research question posed. It allows the researcher to gather knowledge passed on by a large number of experts, and by synthesizing their data and analysis on the subject at hand, such a review can produce a large quantity of relevant information. As the researcher learns more about the subject, the research question posed may even transform: “The literature review can play an extremely important role in shaping your research problem because the process of reviewing the literature helps you to understand the subject area better and thus helps you conceptualize your research problem clearly and precisely,” (Kumar 2005:30).

Several steps are involved in a literature review. Arlene Fink (2010) divides the task into seven distinct stages:

- 1) selecting the research question
- 2) selecting bibliographic or article databases, web sites, and other sources
- 3) choosing search terms

- 4) applying practical screening material
- 5) applying methodological screening criteria
- 6) doing the review
- 7) synthesizing the results

In layman's terms, doing the review translates to reading the material, and synthesizing the results involves writing up a final report in which the researcher fuses together information from the sources used. Using a multiplicity of different sources bolsters the value of the research.

Finally, when selecting material, it is important to ensure the literature comes from a respected source; the final report can only be as trusted as the sources upon which the researcher relies. Fink writes, "High quality literature reviews base their findings on evidence from controlled experimentation and observation. They rely on the researcher's original studies for information rather than on other people's interpretations of the results. Editorials and testimonials are usually excluded from the review itself because they are subjective and prone to bias," (2010:13). This concept of screening appropriate sources brings us to the need for discourse analysis during a literature review.

Discourse Analysis

Discourse analysis involves analyzing any discourse – whether it be a book, article, photograph, television show, or other representation of reality – to understand what motivates the author to present the discourse in a particular way, as well as what motivates the interpreter to understand the discourse in a certain way. What background does the author/photographer/artist have that makes him present his version of reality in such a way? Are there any underlying biases? What background do I, the interpreter, have that makes me interpret the discourse the way that I do?

In the case of a literature review, both the author's and the reader's ways of seeing the world manipulate the way in which a discourse is viewed. Because every brain construes reality differently, no single version of the world can be accepted as an undisputed fact. Uwe Flick writes, "If qualitative research relies on understanding social realities through interpretation of texts, two questions become especially relevant: what happens in the translation of reality into text, and what happens in the re-translation of texts into reality or in inferring from texts to reality?" (83). In this discourse analysis, I attempted to take into account the authors' prejudices as well as my own.

- Author's Bias -

When analyzing a text, it is critical to be aware of the author's background to flesh out any potential biases that could be lurking underneath the surface of the words. The words chosen, or rhetoric, can reveal such partiality (Potter 1996). Flick details the impossibility of purely objective social science writings, as the author's personal experiences color his or her re-creation of reality: "In terms of crisis of representation...it is doubted that social researchers can 'directly capture lived experience'. Such experience, it is now argued, is created in the social text written by the researcher. This is the crisis of representation. It...makes the direct link between

experience and text problematic,” (84). Regardless of intentions, personal prejudices often seep into a text whether the author is conscious of this or not.

In the case of this research study, certain authors related vehement opinions. Richard Paarlberg, for example, seemed quite angry in his distaste for anti-GMO policies and strongly supports Genetically Modified Organisms being used in Africa. Because the passion he felt came across so forcefully, I had an obligation to cross-check his data with other sources to ensure that he was representing facts correctly, and not letting bias cloud his better social scientist judgment. In this particular example, his data was properly presented, not misconstrued to mislead the reader into siding with Paarlberg’s argument.

-Reader’s Bias -

Just as the author paints his or her own version of reality when creating a discourse, so too the reader constructs his or her own version upon interpretation of a text or picture. As such, it is crucial to remain conscious of one’s own prejudices when interpreting any discourse in a fair manner. Flick writes, “Reading and understanding texts becomes an active process of producing reality, which involves not only the author of (in our case social sciences) texts, but also by the person for whom they are written and who reads them...the person who reads and interprets the written text is a involved in the construction of reality as the person who writes the text” (87). As a researcher relying upon literature review, I must constantly ask myself why I interpret each book or article the way that I do, and whether any preconceived notions are coloring how I read each text.

Though I have no personal first hand experiences or financial investment in agricultural research and development, I entered this research project with a certain ideas on how the agriculture industry functions from previous studies. I am also aware that I tend to be very cynical of the motives of politicians, and because of this prejudice, I had to remind myself to enter into this research question with an open mind. Instead of assuming government officials are out to secure themselves money and power, it was important for me to focus on the information in the literature, and whether it truly showed that agricultural funding is politically motivated. In this thesis, I had to be open to the possibility of politicians who truly were trying their hardest to help the people of their nations and not just themselves; undoubtedly some of these do exist.

Drawbacks of Literature Review

Despite the aforementioned benefits of literature reviews, such as using information and analysis procured by experts with years of experience, there are drawbacks as well. For one, not being able to investigate the region of one’s study first hand always takes away from the researcher’s ability to truly absorb oneself into the issue. Because the researcher relies upon others for information, there is a danger the researcher will simply restate the opinion of those authors without bringing his or her own unique view to the final paper. Neergaard and Ulhøi write, “A

literature review needs to be analytical rather than descriptive. If the review simply restates everyone else's work, it will be lacking," (2007:467). In addition, timeliness of sources can be an issue; though a theory proposed in the 1950s may still be valid, using data that is even a few years old can lead the researcher to misinterpret reality. For example, in this study, most of the data from as recently as 2008 depicted a dismal picture as far as how little governments in sub-Saharan Africa were spending on agricultural R&D. And while this is still the case for many nations, in the past few years several countries such as Ghana and Malawi have stepped up funding for the sector. Without current data, it can be difficult to make a valid argument one way or another on the current state of agriculture, or any other issue: "Another aspect of the literature review is timeliness. A review that includes nothing more recent than 1995 or older than 1995 will be considered dated, and reviewers will almost always catch this," (Neergaard and Uihøi 2007:467). Looking at historical or theoretical information from older sources is certainly acceptable, but quantitative data must be from recent sources. Finally, problems arose when different sources presented conflicting data on the same topic. In these cases, it was necessary to cross-reference the information with several more sources to determine which text appeared more accurate.

Brief History of Agricultural Research and Development

The history of agricultural research and development in sub-Saharan Africa is a story of unfulfilled potentials, with a series of budding successes stifled by inconsistencies in funding. The choppiness of support – moderate funding for a project one year under administration A, zero funding the next year under administration B – has been a common theme throughout the continent (Djurfeldt et al 2005). Larsson, Holmen and Hammarskjöld write, "The problem with the African food crisis is not that governments have been reluctant to 'interfere' in the agricultural sector....However, most of these attempts to intensify have failed in terms of fiscal sustainability" (2002:14). While high yield varieties (HYVs) and other agricultural science investments have been adopted and exploited in a number of countries over a short period of time, adequate support for a prolonged period of time has been scarce, and those projects that *have* received consistent attention tend to be geared toward large-scale commercial farmers and cash crops, rather than toward small-scale farmers and staple crops (Ibid). Nigeria, for example, has spent the second most in Africa on agricultural R&D in terms of absolute dollars since independence (Pardey, Alston and Piggott 2006); though some hybrid varieties have been fruitfully grown by poor farmers there, yield increases do not reflect the large amounts of money spent because of uneven funding (Ibid).

Prior to the influx of Europeans (and even to a large extent today), crop increases in sub-Saharan Africa largely resulted from expanding land area under cultivation (*extensification*) rather than

increasing output per plot (*intensification*). There were, however, a number of low-tech agricultural techniques aimed at increasing crop yield on a given plot. Common practices included intercropping, crop rotation, leaving fields fallow, applying compost, and spreading organic fertilizers like livestock manure along with the seeds (Martin and O'Meara 1995). Though today's large-scale commercial farmers have traded such systems for more science-inspired methods like tractors, chemical fertilizers, complex irrigation systems, incorporation of hybrid seeds and so on, these time-proven lower technology methods are still used by small-scale farmers across the continent.

Colonization introduced a large number of white farmers and their science-driven farming techniques to Africa. Cash crops were the focus of colonial administrations: "Europeans invested in research to improve some of the specialty crops Africans were obliged to grow for export – such as cocoa, coffee, tea, cotton, peanuts, and sugar – but traditional African food crops such as millet, cassava, yams, and sorghum remained mostly unimproved by scientific plant breeding" (Paarlberg 2008:83). White commercial agriculturalists in Zimbabwe (then Rhodesia) benefitted from a government eager to introduce high yielding varieties into the country, and breakthroughs of hybrid maize were introduced in 1949 and later in the 1960s (Larsson, Holmen, and Hammarskjold 2002). But these efficient, white-run, large-scale farms were returned to the native black population several years after the racist Rhodesian government ceded power to Robert Mugabe and his Zanu-PF government. In the process land was sub-divided into smaller plots, not only hurting economies of scale but placing the land in the hands of those inexperienced with agricultural technology (Chazan et al 1999). In spite of this, at first, Zimbabwe enjoyed a resurgence in agricultural production when the young government promoted agricultural technology in the 1980s (Eicher 1995), but political and fiscal inability to sustain these increases led to an eventual decline in production (Ibid). Agricultural science was no longer employed to the same extent as before, and Zimbabwe tumbled from its position as the 'breadbasket' of southern Africa to importing emergency food aid in a few years time. Kenya too enjoyed periods of expansion with seed hybridization programs, and like Zimbabwe, managed a large-scale, albeit relatively short lived, Green Revolution in the 1960s. Yet these technologies were directed towards white commercial farmers and had little positive effect on subsistence farmers (though some agricultural science did trickle down), especially those without fertilizers to complement the new seeds (Larsson, Holmen, and Hammarskjold 2002). Though initially promising, Kenya's push for a sustained Green Revolution was hampered by governmental corruption, mismanagement and political infighting, and collapsed by the mid 1970s (Bates 1981).

Despite the relatively low level of agricultural research and development funding granted for staple crop improvements, African food supply was fairly stable around the time of decolonization (Martin and O'Meara 1995). As faltering agricultural yields were not a pressing

issue at the time, many administrations may have overlooked the sector's importance. But a few decades of neglect for the agriculture combined with poor policy decisions, both on the part of African governments and international institutions like the IMF, left Africa starving. Djurfeldt et al chronicle the shift: "At the time of independence, most of sub-Saharan Africa was self-sufficient in food. In less than 40 years, the subcontinent went from being a net-exporter of basic food staples to reliance on imports and food aid," (2005:2). So what happened?

The assault on agriculture during the years following independence can be pinned on a number of factors, including the rise of national governments concerned with solidifying shaky power bases, stringent Structural Adjustment Policies (SAPs) and the promotion of Import Substitution Industrialization (ISI) development, decreases in technology spillovers, and a drop in international agricultural aid. First, leaders in Africa at this time felt little nationalist pride and did not have a developmental mindset; instead they were concerned with securing resources for themselves and their ethnic kinsmen (Herbst 2000). Because agricultural production was fairly stable in 1960s Africa, agricultural science did not grab the attention of leaders, who had more pressing matters (in their minds) to look after. Atul Kohli explains, "The new leaders, personalistic and preoccupied with communal affairs, accentuated these defects by further polarizing ethnic conflicts and by pursuing kinship gains at the expense of national development" (2004:338). Here exclusion theory comes into play. Furthermore, these individuals were hardly well suited to run a country by themselves, let alone while trying to collaborate with 'enemy' tribes. As Chazan et al note, "At independence, African countries displayed a particularly burdensome inheritance: the absence of a shared political culture....Many leaders of the anti-colonial movements had neither the tools nor the time to guide their followers through the complex move from defiance to constructive interaction" (1999:29). Those individuals best suited to lead an anti-colonial movement were not necessarily the best fit to lead a newly-born state in desperate need of sound economic, social, and political policies. While emerging politicians and military leaders were left to bicker over the spoils of a young nation, development – agricultural development in particular – was pushed aside.

As a point of contrast with the rest of the world, by the time of African decolonization (predominantly the 1960s) Norman Borlaug and his team had already developed an improved wheat variety³ while working in Mexico some twenty years earlier, a breakthrough that eventually spurred the development of improved rice varieties in the Philippines. This led to the development of IR-8, a high yielding rice variety created in the Philippines that was distributed widely by Asian governments beginning in 1966 (Djurfeldt et al 2005). The introduction of IR-8 set off the Asian Green Revolution. As mentioned before, Asian governments were eager to take advantage of this improved crop so as to appease hungry rural dwellers and stabilize their regimes.

³ The improved wheat variety had a shorter stem, which allowed for absorption of more nitrogen fertilizers without the plant falling over, or lodging (Djurfeldt et al 2005).

Yet in Africa, agricultural policy fell into the political domain in a different manner. Rather than seeing the sector as a means to stabilize rural constituents and in turn their own administrations, or concern themselves with humanitarian rationale, leaders in post-independence sub-Saharan Africa had a preference to set food prices at artificially low rates so that urban – and more politically powerful – dwellers would benefit. This hurt rural producers. Holmén explains,

“State monopolies in the handling of agricultural input and products became the rule. This enabled governments to regulate prices... Fixed prices squeezed the margins between costs of production and revenues from sale of produce for both smallholders and traders and, hence, reduced the incentive to produce a marketable surplus. With governments’ priorities increasingly emphasizing low (urban) consumer prices rather than improved (rural) producer prices, the result was maintaining the *status quo* rather than agricultural development. Surplus production under these circumstances was not always attractive and where conditions deteriorated too much, smallholders were reported to be withdrawing into subsistence production,” (2005:88).

These governments displayed an urban bias with regard to agricultural policy, opting to appease urban voters with cheap food despite the havoc it wreaked on rural producers and the agricultural sector at large. Spending on agricultural research and development during this period dropped off precipitously (IFPRI 2008). One positive silver lining for smallholder farmers in this period was the protectionist policies their governments tended to set (Herbst 2000). By placing high taxes on imported foodstuffs, local farmers were able to get a small toehold in the marketplace.

This downward shift in spending and policy priorities from governments was compounded by the Structural Adjustment Policies, in which the IMF advised African administrations to cut spending on social programs in order to pull their struggling nations out of debt. African governments, which had marginally protected their farmers from outside competition – foreign competition was often subsidized at home anyway, thus creating an unfair playing field – were forced to take a step back from the little help they *did* provide to their farmers: “SAPs restricted the role of the state and encouraged an open market, which crushed local producers who had to compete against subsidized foreign imports,” (Pardery et al 2006:235). In addition, SAPs encouraged cash crops over subsistence crops in order to generate hard currency; in a region with falling food production, such directives were irresponsible to say the least. Fertilizer usage decreased as subsidies for farmers dried up so that money could go to repay loans, further hurting the agricultural sector (Djurfeldt et al 2005). In addition, ISI development strategies were encouraged by the World Bank and the IMF, and consequently pursued by poor states across the globe – reinforcing the ubiquitous urban bias, as promoting industry would benefit city dwellers, not rural.

Agricultural science in Africa not only took a hit from decreased spending at home, but from a decline in technology spillovers and agricultural aid from abroad. Technology spillovers had often provided valuable new methods to agriculturalists living in LDCs, as science developed in wealthy nations eventually made its way to Africa and was exploited by whoever was lucky enough to implement the new techniques. However, as wealthy countries became more food

secure, they invested less of their own money in agricultural R&D; because the United States and Europe did not need to increase their crop yields any more, they cut public funding to their own R&D budgets, thus severing a major source of technology that could have spilled over to Africa (Paarlberg 2008).⁴ This decrease in spending at home translated into a decrease in international aid for the agricultural research and development sector: “When rich countries began reining in their investments in agricultural science at home, they simultaneously began withdrawing international assistance to agricultural science in poor countries abroad, with particularly damaging consequences for Africa,” (Paarlberg 2008:2). The drop in aid continued through the turn of the century: between 1980 and 2003, agricultural ODA to poor countries fell from \$5.3 billion to 1.9 billion (Oxfam 2006); during this same time period, Great Britain, Germany, France, and the US all slashed their aid for African agriculture by an average of 75% (Ibid). Thus, agricultural science in sub-Saharan Africa in the 1970s and 80s was hit from a number of sides at once: national governments favoring low prices for urban consumers, a decrease in resources available due to SAPs, drop in technology spillovers, and drop in international aid marked for the sector.

Diminishing agricultural R&D support mirrored the resultant decline in per capita food production: per capita output of cereals has stagnated or declined in all parts of Africa since independence (Djurfeldt 2005). Paarlberg writes, “In 1966-70, the African continent was still a net exporter of food, but by the late 1970s [after SAPs had gone into effect] it was importing 4.4 million tons of food each year. By 2002, sub-Saharan Africa was importing 19 million tons of food, with more than 15% of these imports coming in the form of food aid,” (2008:5). What had once been a relatively healthy agricultural sector was transformed into a weak one that left millions hungry.

Agricultural R&D Today

While agricultural research and development funding remains underfunded today, the situation is not quite as dismal in all parts of the continent as it was only a few years ago. Steven Wiggins writes, “Interest in African agriculture is being rekindled after decades of relative neglect by both governments and donors – and corresponding slow growth of the sector. For most countries, agriculture has to grow if the economy is to develop and if rural poverty is to be alleviated,” (2005:1). Using data as recently as 2000, it appears African was the only region of the world in which agricultural R&D funding declined (Beintema and Stads 2008). Ironically, the countries that rely upon agriculture the most to support their GDP spend the fewest resources upon agricultural R&D [see appendix D]. Yet increased attention of late has proven a boon for the sector. As international food prices are rising, crops are becoming more respected by governments as a way to increase a nation’s agricultural and economic prowess (Perkins 2008; Mbola 2008). Biadine notes, “The recent spike in global food prices represents an opportunity

⁴ While private R&D spending increased in wealthy nations, such science targeted cash crops important to commercial farmers, not those most valuable to poor African smallholders.

that could support further agricultural sector growth in Africa,” (2008:1). Of course, this does not bode well for those suffering from higher food prices: “Global food prices have skyrocketed in the past year, sparking riots in 2008 in cities from Egypt to Haiti. Rising prices pose a particular threat in sub-Saharan Africa, where conflicts and drought exacerbate the affects of high prices. Agronomists say the continent needs to drastically increase its agricultural productivity...The region’s economic development may depend upon such a revolution, experts say, but it will require strong support from individual African governments,” (Hanson 2008:2). Though food riots are a negative sign in that they highlight failure of governments to become food secure, they are positive in that their highly public nature pressures governments to act quickly to rectify the situation. And, as the case of the Asian Green Revolution shows, when a government feels threatened by food issues, it is much more likely to address them. In this case, because continuous land expansion is a difficult prospect with a limited supply of good quality soils, intensification is being turned to as the solution for increase food supply as global prices climb. Here agricultural research and development comes into play. Now, politicians view agriculture as a vehicle to benefit their political parties and themselves. And it is not only national governments who have amplified focus on the sector. International attention has jumped in recent years as well, with aid flows earmarked for agriculture climbing from 1% of worldwide ODA to 5% (IFPRI 2010). Though it still represents a small percentage of total global bilateral aid, this makes a notable improvement.

In addition to rising food prices, another noteworthy push in increasing funding for agricultural development came in 2003 at the Second Ordinary Session of the AU Assembly in Maputo, Mozambique. Governments signed a pledge promising, among other things, to allot a significantly increased percentage of their national budgets on agriculture, promising a minimum of 10% (Hanson 2008). The final agreement reads, “We agree to adopt sound policies for agricultural and rural development, and commit ourselves to allocating at least 10% of national budgetary resources for their implementation within five years,” (AU 2003). [Of course, the raised profile of agriculture as a whole does not necessarily mean that agricultural science or long-term agricultural goals will be addressed; governments may choose to spend all of their agricultural budgets on unsustainable practices like handing out food aid, but in any case, any increase in attention on agricultural is positive]. Actual implementation has varied: according to the New Partnership for Africa’s Development (NEPAD), Malawi, Rwanda, Tanzania, Mali, Ethiopia, Ghana, and Nigeria have already met this goal (2009:1), while others are still lagging behind. Data for some states is conflicting. In the case of Uganda, while some sources claim the country is doing well in the agricultural sector (Biadine 2008), others relate that the country has failed with a *decrease* in agriculture as a share of total GDP and stagnating 4% investment of the total budget on agriculture: “Unfortunately, the government of Uganda’s commitment to developing the agricultural sector continues to be limited considering the actual levels of funding and strategic policy interventions,” (Muhereza 2009:4). In any case, the general consensus of

experts is that on the whole, agricultural research and development is receiving more attention – and consequently more funding - today than several years earlier, an extremely positive step in the fight against hunger and poverty in sub-Saharan Africa.

Political Interest Groups of Sub-Saharan Africa

Ethnic Groups

Like any government-funded activity, policies for agricultural science are a product of political constraints. Stephen Briggs and John Farrington note, “Agricultural research and promotion cannot be seen as neutral, technical activities; instead they are fundamentally integrated over time with political, economic, and institutional events,” (1991:vii). In order to appreciate the intricacies of agricultural funding and policy making by sub-Saharan African governments, it is necessary to have a grasp on the ethno-political climate of the region. As mentioned before, most of these nations’ borders were drawn up by departing imperial powers whose haphazard partitioning of the continent left any number of tribes under one government without considering the relationships between these ethnic groups (Herbst 2000). Prior to colonialism, African political structures had been largely decentralized and kinship-based (Oliver and Atmore 2005). These traditions were a far cry from the centralized and ideologically based power system installed upon decolonization. Since these artificially created entities did not develop naturally, but rather were imposed upon them by outsiders, individuals logically related more to their lifelong ethnic identities than to new state identities; one felt Ibo, Hausa or Yoruba, for example, rather than Nigerian. Countless civil wars and insurrections have broken out as a result of these irresponsibly created, forced nations: Rwanda, Uganda, Nigeria, and Kenya provide just a few examples of countries that have plunged into battle since independence – often multiple times - over which ethnic group would ascend to power. Faced with an unfamiliar political system, the newly formed African states fell back on old identity patterns, with politicians providing the spoils of power to their kinsmen rather than distributing revenue with the state’s economic, social or agricultural development in mind. Holmén writes,

“Political elites are constrained, inter alia, by history, social structures, and prevailing power relations (Hettne 1973). Social institutions determine the obligations of the political elite, limit their autonomy and strongly impact upon what can be done and how....The state became a target in factional struggles rather than a tool to be used for the realization of policy....African states – permeated by neo-patrimonial rule and the informalization and personalization of power – were typically looted by their servants in order to honor obligations toward sub-national communities such as tribe and kinship,” (2005:90).

The tribe-first, country-second attitude pervasive in African governments continues today. This provides support for exclusion theory, which posits that when one group attains power it will secure as many resources for itself as possible and prevent competing groups from acquiring any. Like everything else controlled by government policy, the agricultural sector reflects these

nepotistic qualities. Bienen sums up the distribution of government spending in sub-Saharan Africa: “Because resources are limited, political actors often provide economic rewards to loyal supporters on the basis of personal and communal loyalties,” (1987:298).

Other Competing Interest Groups

It is not just competing ethnic groups, but competing economic interest groups within countries that direct the flow of policymaking. Certain commercial producer organizations, for example, may push for favorable legislation like input subsidies or tax breaks. Several interest groups square off when there are finite resources for agriculture, and these interactions help dictate the formation of agricultural policy: smallholder vs. largeholder farmers, urban consumers vs. rural producers, commercial farmers of different crops competing against one another for beneficial treatment. Whichever interest group can provide the most benefit – usually money or political support - to the politician will receive favorable treatment: “The legislator can help the interest group, collecting campaign contributions and political support in exchange, or can decline to help the interest group, creating an adversary. In either case, the general public will be uninformed about the legislator’s actions. Thus, there is a strong bias for legislation to favor benefits for special interests over the general public interest” (Holcombe 2002:263). The ruling government considers the voices of different special interest or lobbyist groups before determining policy. When certain groups possess more political power than others, they will secure more resources from the government, as the ruling regime wishes to make politically influential groups happy. This demonstrates the appropriateness of Decision Making theory – governments want to retain power, and consequently assist those groups that they deem are in the best place to keep them there.

The agricultural sector is a prime example of such policymaking mechanisms. Large scale farmers, who tend to be wealthier, more educated, and consequently more powerful than smallholders, receive far superior treatment from national governments (Oliver and Atmore 2005). When slicing up a pie that is already small – not much money goes toward agriculture in the first place – subsistence farmers ultimately obtain so little of the allotment that they are virtually ignored. Robert Bates writes, “It is commonly and almost universally found that poorer, small-scale, village-level farmers do *not* secure farm inputs that have been publicly provisioned and publicly subsidized as part of programs of agricultural development. The evidence suggests that the benefits of these programs have been consumed chiefly by larger farmers, sometimes at the expense of their smaller counterparts,” (1981:55). Most impoverished farmers are hardly considered politically valuable to rulers. The lack of resources directed at them reflects this: “In areas described as marginal, remote, and low potential, the majority of the rural population comprises small-scale farmers and laborers whose political strength is generally low. These farmers are unlikely to pull either general development policies or R&D agendas toward their needs,” (Briggs and Farrington 1991:51).

Unlike smallholders, large scale commercial farmers often unionize to increase their political clout, a move which has proven quite effective: cocoa unions in Ghana, rice unions in Kenya, and groundnut unions in Senegal, for example, have all flexed enough muscle to maneuver legislation in ways that increase the government-set prices of their products (Bates 1981). Bates

continues, “[There is] the ability of large-scale farmers to act collectively in defense of their interests. Being large in size, each stands to reap substantial benefits from higher prices...Insofar as public policy reflects the lobbying efforts of the citizenry, it therefore tends to favor the large farmer,” (1981:95). This demonstrates the relevance of Pluralist theory, or “bargaining between groups that contributes as much to policy as does formal democracy” (Miller et al 1987:425), for agricultural policymaking in Africa. Various groups maneuver to influence legislation. In addition, disparities in rural farmers’ power (and consequently incomes) largely relates to their interactions with city dwellers: “Inequalities within rural areas also owe much to the urban-biased nature of development policy. The cities want to receive, preferably cheap, surpluses from the rural areas...Who, in the rural areas, can provide such surpluses? Clearly, the better off, especially the big farmers,” (Lipton 1977:68). Leaders weigh the needs and the power of various groups when crafting agricultural legislation, and it appears the smallholders lose out.

As mentioned before, the tension between urban consumers’ need for low food prices and rural producers’ desire for high prices also forms opposing interest groups. Because national governments in sub-Saharan Africa typically view urban constituents as more politically powerful, it is the city dwellers that benefit from policies created with their best interest in mind. Bates notes, “Governments face a dilemma [of] urban unrest which poses a serious challenge to their interests. Their response has been to try to appease urban interests...by advocating policies aimed at reducing cost of living, and in particular the cost of food. Agricultural policy thus becomes a byproduct of political relations between governments and their urban constituents,” (1981:33). Just as commercial farmers in sub-Saharan Africa typically win out over subsistence farmers when it comes to the allocation of agricultural services from the government, so too urbanites win out over rural inhabitants when the government creates agricultural policies that dictate food prices. Lipton writes, “The actions of the powerful, in almost all developing countries, have shifted income-per-person – inefficiencies and inequities notwithstanding – from rural to urban areas. Agriculture, with 70% of workers and 40-45% of GNP, has in most poor countries received barely 20% of investment, but has, directly or indirectly, been induced or forced to contribute considerably more toward saving...The urban elite, for all the well meaning talk of rural development, is in practice driven to concentrate heavily on cities” (1977:67). The seemingly inescapable urban bias in sub-Saharan politics only exacerbates the problems struggling smallholders face.

While it appears that smallholders and rural dwellers are stuck on the bottom of the political totem pole, one group that receives even less attention is landless rural laborers. Not only do they miss out on the goods and services provided for commercial farmers and urban inhabitants, but they fail to substantially benefit from whatever little resources trickle down to rural small scale farmers. Fortunately, the landless do not constitute a large group, and are nowhere near the landless Asian groups in either absolute or percentage terms; still, it is important to recognize their existence, however few they might be. Michael Lipton writes, “Increasingly...the poor are

mainly ‘landless and near landless laborers’. It is a different task and probably a harder one, to steer the benefits of agricultural research towards laborers than towards smallholders. Unorganized, dispersed rural laborers are usually the least powerful group of all,” (1988:4). Though it is possible the landless rural dwellers could still benefit indirectly through agricultural technology – certainly higher yields could stave off starving to a greater degree, if they are able to access this extra food – the sad fact remains that there is a segment of the population so powerless that even legislation directed at ‘the rural poor’ would overlook them. Lipton continues, “Pressures and agenda can interact – even where administrators and politicians want MV (modern variety) research that responds to poverty – to conceptualize poverty wrongly. For example, most MV research is for ‘small farmers’ though the poorest increasingly are near-landless laborers. Science does not respond only to such demands and pressures” (1988:98). For agricultural technology to make a big impact on poverty, it must find a way to address the needs not only of ethnically disfavored groups, rural inhabitants and smallholders, but landless laborers as well.

African vs Asian Governments: A Difference in Agricultural Attitudes

Comparing the attitude taken by Asian governments⁵ on the eve of the Asian Green Revolution with the attitude of post-independence governments in Africa sheds more light on the heavy influence political needs have upon agricultural policy. It is clear in both cases that whichever segment of the population the government deemed politically influential received more attention. In the case of the Asian Green Revolution, authoritarian administrations feared farmers would mobilize against them if they did not have enough food to eat and enough surplus to sell for profit; seeking legitimacy in the eyes of their rural constituents, these governments eagerly pursued the use of agricultural science and facilitated the spread of hybrid seeds. Akande et al write of the Asian rulers at the time,

“They did not opt for Green Revolutions in the 1960s out of enlightenment or altruism. All faced serious threats, which could have removed them from power and even threatened their physical survival. The threat of famines loomed, as did the fear that food scarcity could lead to uprisings or communist revolutions. Ruling elites felt that, at the very least, they had to make sure that their constituencies had enough food to stay calm. These circumstance translated into far-reaching modernization programs....All had in common Green Revolution policies deliberately aimed at including the smallholder,” (2005:253).

⁵ Asian governments, just like African governments, were not identical in their agricultural policies, and I do not wish to ignore the differences in the Green Revolutions in China, India, and other South East Asian states. Yet certain political motivations were pervasive in Asia during the Green Revolutions, and it is these similarities that I analyze. The specifics of Asian states’ policies are beyond the scope of this paper.

African governments, on the other hand, saw things differently. As mentioned before, they were accustomed to living in relatively food secure circumstances, and as such may not have felt it necessary to pour resources into agriculture. These administrations preferred to focus on urban voters, and consequently turned attention away from agricultural research and development. *Politics and Society in Contemporary Africa* explains that “African regimes have typically been concerned with maintaining stability in urban areas...where influential groups have close proximity to officials...Rural producers have few political resources to defend against discriminatory measures” (Chazan et. al 1999:289-290). Even in non-democratic countries, urban inhabitants were seen as more likely to mobilize, as they were closer to sources of news and education, and ultimately more likely to overthrow a regime that they disliked (Martin and O’Meara 1995). IBRD continues this line of thought: “Policies that excessively tax agriculture and underinvest in agriculture are to blame [for low food production in Africa], reflecting a political economy in which urban interests have the upper hand. Compared with successful transforming countries when they still had a high share of agriculture in GDP, the agriculture based countries have very low public spending in agriculture,” (2009:7).

This comparison reinforces the soundness of Decision Making theory. Governments behave so as to get re-elected. While some governments may be lucky enough to have deep pockets and thus spread social spending across a broad spectrum of constituents, governments in sub-Saharan Africa are constrained by small budgets that have countless demands. They have no extra funds for politically weak citizens, even if they are hungry or impoverished. Simply put, governments want to retain power, and the divergent treatment of agricultural research and development in Asia and Africa over the last 50 years is a testament to that. Djurfeldt et al write,

“In Asia, recurring famines, dependence on food imports and threats of war were difficulties that urgently needed to be resolved – if the governments were to survive. In contrast...It appears that in Africa the nation-building project took precedence over development in general and food self-sufficiency in particular...Control, it appears, was given higher priority than development. As a consequence few if any African governments have managed to establish themselves as ‘developmental states’ despite their willingness to present themselves as such,” (2005:17).

It is not just the handling of agricultural research and development in newly post-independence Africa that demonstrates Decision Making theory, but how the governments handle it today. Of late, the sector has grown in importance, and consequently so too has government focus upon it: “To an increasing degree African governments, if they want to remain in power, have to make serious efforts to develop the internal resources of their countries....It is therefore no surprise that we have documented signs that governments in some sub-Saharan countries...resume a more active role in promoting food crop agriculture,” (Akande et. al. 2005:257). While the increases in attention are undeniably playing a positive role in growing funding for the long-

ignored sector, it nonetheless continues to receive insufficient interest of policymakers. Larsson, Holmen and Hammaraskjold write, "Although food crop research may still not receive sufficient attention, not least in the case of cassava, sorghum, and millet, evidence of a number of high-impact innovations generated from Africa's food crop research programs can no longer be denied," (2002:35). Progress is slow, but at the very least is there in some capacity.

The culmination of all of these political calculations means that agricultural science, an 'unexciting' area, remains underfunded, despite volumes of studies declaring its long term benefits. Lord Todd provides some valuable insight: "We still try to run a 20th century world dominated by scientific progress with 19th century politics. We must remember that in government the ultimate decisions are political and not scientific," (1968:1). Certain aspects of agricultural research and development are incompatible with the realities of African politics, most notably the time lag between funding for agricultural science and visible results.

Incompatibility of Agricultural Research and Development and African Politics

Because politicians in any governmental system want to shore up political capital, it is in their own best interest to keep the citizenry, or at least those with political influence, content. Whether politicians are held accountable during elections or fear violent revolts if they do not deliver adequate resources, on some level, almost all governments eventually answer to the people in one way or another; as many dictators could attest, even if they avoid answering for poor policies and brutal treatment of citizens during elections, they will likely face an eventual coup. Autocrats like Idi Amin of Uganda, Haile Selassie of Ethiopia, and Gafaar Mohamed Nimeiri of Sudan illustrate that even a despotic regime can be overthrown without elections, should the country's citizens revolt en masse. While government accountability is doubtless positive in most respects, one downside is that politicians feel pressure to deliver benefits in the immediate future, even if doing so saps their ability to satisfy long-term goals. Politicians must constantly measure how long a policy will take to manifest positive results, and compare this to when he or she will face elections. Waldo writes, "Time is an entity or area of policy, and the decision maker's most precious resource. The policymaker must constantly be aware that time forms a milieu within which he must perform his developmental functions. Within this milieu he is constantly calculating and recalculating strategy, dealing in tradeoffs and transformations among the various factors of wealth and power, deprivations and satisfactions," (1969:397). In a democracy, administrators who seek re-election are tempted appease voters *now*, prior to elections, which is more appealing than giving them abstract promises of potential future gains. Short election cycles or volatile governments lead to short term goals and projects. As Bienen says, "The time horizons of policymakers are short," (1987:307). Though suitable for some projects, these short term cycles often stifle the possibilities of longer term goals that would

eventually benefit the nation more. Economic policies are a common example of such behavior. Journalist Paul Krugman found politicians in the US, for example, are extremely reticent to embrace future-oriented economics programs, as the immediate sacrifices these would entail would prove a hard sell to voters (1994). Delayed gratification is difficult for politicians to accept.

Scientific funding is especially vulnerable to this phenomenon. Unlike opening public coffers for tangible and instantaneously impactful programs like welfare payments or construction projects, research and development for any sector takes time, and is much less visible to the public eye. Roseboom et al write, "There are substantial lags between the investment in research and the generation of new ideas and innovations, and further lengthy periods before the productivity consequences of these new findings are fully realized," (2000:55). Agricultural research and development is no different from other investments in science. There is a "long gestation period for new crop varieties and livestock breeds [which] encourages an over-emphasis on short term projects or on projects with short lags between investment, outcome, and adaptation," (Pardey, Alston and Piggott 2006:367). In fact, "agricultural research programs often take ten years or more to bear fruit- probably more years in Africa due to more demanding systems and conditions for technology spread and adoption," (Larsson, Holmen and Hammarskjold 2002:34) [see appendix E]. Such delays hardly encourage investment.

The NARS of South Africa, known as the ARC, has fallen victim to just such near-sightedness. Impatient with what it considered slow progress, the government demanded the ARC set three year budget proposals, which it deemed 'medium term' planning (Liebenberg and Kristen 2006); while three years may be considered medium term in the life of a politician, it is quite short in terms of agricultural innovation. As such, it seems that the demands of politicians and the needs of agricultural research and development are incompatible: "Political leaders in all developing countries will face strong temptations to underinvest in scientific research, since their political time horizons will be short compared to the significant time lag (on average ten years in the case of agriculture) between making a research investment and getting the first tangible local payoff. Research and development spending is particularly easy for leaders in poor countries to neglect, since smallholder farmers in developing countries tend to be a weak political constituency," (Paarlberg 2008:90). As Paarlberg mentions at the end of his quotation, smallholders in particular lose out from this time lag. Commercial farmers can afford private research and development investments, either as individuals or as producer organizations, whereas subsistence farmers have no other option than to rely upon what is publicly provided. Legislators do not feel an urgency to invest in long-term solutions for this politically expendable constituency: "The desire for a quick fix in agriculture, and especially in domestic food production, has been a general phenomenon in Africa....There has been a feeling among policymakers that investments

in the smallholder sector of agriculture would take too long to pay off, if they paid off at all,” (Bienen 1987:303).

Though this thesis focuses on the behavior of national governments towards domestically supported agricultural research and development, it is important to note that the emphasis on short-term over long-term goals extends to foreign donors as well, who pressure recipient countries to constantly produce immediate results from grants. Briggs and Farrington write, “Many international donors are currently too strongly geared to short-term project cycles to be appropriate for difficult environments. They stress the short-term expectations, strict disbursement schedules, and highly quantified evaluations based on narrow criteria. If research for these environments is to succeed, however, it will have to be long term,” (1991:73). It is not only bilateral agricultural aid donors that demand instant gratification, but international institutions as well. At the turn of the century, for example, the World Bank caved to demands to provide reports concluding the success or failure of loans almost immediately after disbursement. Paarlberg explains, “To appease criticism from the right, the World Bank tried to adapt a more ‘corporate’ management model that called for loan impacts within a shortened three to five year time frame (Falcon and Naylor 2005). International agricultural science, which does not deliver results within a three to five year time frame, was disadvantaged in this new environment,” (2008:97). It appears that the pressure to deliver instantaneous results from funding is universal rather than a burden borne only by national governments facing re-election.

GMOs

Agricultural R&D and Education

The general lack of regard for agricultural research and development springs from the sector’s relative obscurity in a number of senses: not only is it a relatively trivial topic politically, but many legislators in sub-Saharan Africa do not have a grasp of agricultural science (Paarlberg 2008). If they do not appreciate the powerful potentials of agricultural R&D, or have been lulled into complacency by food stability in preceding decades, it makes sense that they are not fighting harder to fund the sector. Gordon Ward writes, “Policies are often decided by government administrators who do not understand the fundamental importance of scientific research in developing new technologies. Since they do not appreciate the vital contribution which research makes to the progress of a country, they do not provide budgetary and government support,” (1969:91). Without sufficient appreciation for agricultural science, little progress will be made. Most politicians are charged with creating policy for a broad range of issues, and it is unsurprising that they are not fully informed in every field. Though there are agricultural ministries staffed with experts, it is not these experts that make the final funding decisions, but

rather the elected politicians. De Reuck et al comment, “In developing countries, although the politicians may agree to the establishment of certain organizations concerned with what they believe to be the interests of science, there seems to be no understanding by politicians of the real needs of science and of scientists in terms of national goals...one will get an opportunistic approach to science,” (1968:275). Insufficient understanding leads to underfunding. These governments are actually behaving in counterproductive ways, yet believe it is in their own best interest. This fits in with John Elster’s perception of rational choice theory, which says that the idea of maximizing what is best depends upon the person making the decision; however uninformed these politicians may be, they act in accordance with their own perception of ‘good’. As will be demonstrated shortly, GMOs suffer from bad publicity which leads governments in Africa to enact legislation that they believe is in their own best interest, but in reality prevents a valuable agricultural technology from being implemented.

The Fight over GMOs

One of the most well documented instances in which agricultural science’s prospects were snuffed out by lack of understanding is the case of Genetically Modified Organisms, or GMOs. These are alternately referred to as transgenic or GE (genetically engineered) crops. In the context of agriculture, GMOs are plants that have been engineered to carry specific traits beneficial to the farmer or consumer, whether it is a shorter stem to prevent the plant from falling over (known as lodging), a higher tolerance for droughts, resistance to pests, or other favorable characteristics. Scientists manufacture GMOs so that only one desired trait is changed, leaving the rest of the plant DNA identical; neither nutrition, nor taste, nor appearance are altered (unless that is the gene which was intentionally transferred). They perform this operation through recombinant DNA technology. Nancy Mills explains the process: “With recombinant DNA technology, it is possible to cut a small piece of DNA from one species (donor), introduce it into the DNA of another species (host) with which it cannot cross, but in which the donor DNA is expressed. The host species, now called a genetically modified organism (GMO), thus acquires a new property it could not have obtained by conventional breeding (*Nature* 2002)” (2006:1). The potential of including favorable properties in otherwise unchanged plants is enormous: what was once a crop that could not survive without intensive irrigation now can suffice with rainwater only; or a plant that used to be plagued by insects is now resistant. A handful of countries have already taken advantage of this agricultural technology. The United States, Argentina, Brazil, and Mexico have all exploited the benefits of GMOs, with the first generation of GM maize crops appearing in the US in the mid 1990s and continuing in mass production today. The World Health Organization (WHO) explains the draw: “GM foods are developed – and marketed – because there is some perceived advantage either to the producer or consumer of these foods. This is meant to translate into a product with a lower price, greater benefit (in terms of durability or nutritional value) or both,” (2010). Such benefits are a great boon to farmers, or if improved

nutrition is targeted, the consumers. A recent study of GMO use in the US confirms their advantages, though cautions against overuse, which would allow pests to adapt to the new technology, potentially rendering it useless: “Genetically engineered crops have provided ‘substantial’ environmental and economic benefits to farmers, but overuse of the technology is threatening to erode the gains, a national science advisory organization said Tuesday,” (Pollack 2010:B3). If used correctly and with proper restraint, GMOs simultaneously reduce the need for pesticides and increase output.

In spite of the well known benefits of GMOs, “the uptake of GM crops has been limited to only a few crops and it has been highly uneven country by country. As of 2006, only 22 countries around the world had any significant commercial plantings of GM crops, and roughly 90% of global GM crop area was still confined to just four countries, all in the Western Hemisphere: the US, Argentina, Brazil and Canada,” (James 2006:1). In Africa, only South Africa has permitted commercial planting, with Burkina Faso likely to follow suit (IFPRI 2010). The IBRD writes, “Low public investment in biotechnology and slow progress in regulating possible environmental and food safety risks have restrained the development of GMOs that could help the poor. The potential benefits of these technologies will be missed unless the international development community sharply increases its support,” (2009:15). Why? A lack of education on the subject has left many individuals, NGOs, and governmental organizations across the world, in developed and developing countries alike, nervous about potential health or environmental hazards that they fear GMOs will create. Many label GM crops as ‘Frankenfoods’, a pejorative term employed to convey the varieties’ laboratory as opposed to natural earth origins. Often groups dislike GM crops because they are concerned the varietal will lead to health problems for the consumers; it is not surprising that engineered food has an unsettling effect upon first glance. Europe in particular has sparked enormous distrust over agricultural biotechnology, with NGOs and government ministries alike fighting against the expansion of GMOs into Africa. Paarlberg writes, “The governments and citizens of Europe continue to exercise considerable postcolonial influence in Africa through a range of mechanisms that include foreign financial and technical assistance, international organization activities, NGO advocacy campaigns, and international commodity markets. Through each of these channels today Europe is telling governments in Africa that it would be best to stay away from agricultural GMOs, and African governments have been responding accordingly,” (2008:111). Europeans’ suspicions have crossed into Africa, and encouraged leaders there to reject this technology.

Yet the intense dislike for GM crops is unfounded. The WHO – surely a group to be respected for its health expertise - asserts “GM foods currently available on the international market have passed risk assessments and are not likely to present risks for human health. In addition, no effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved,” (2010). There has never

been a single documented case of poisoning from GM crops (Paarlberg 2008), but the fear of the unknown remains. Falck-Zepeda, Cavalieri, and Zambrano of IFPRI write, “GE crops released have a remarkable safety record. No proven or documented damage to human health or the environment have been reported for any of the approved GE crops to date. Many major science academies in Europe and the United States, international agencies, and national and regional regulatory agencies officially endorse this safety record,” (2009:2). As hundreds of millions of Americans, Mexicans, Brazilians, and other residents of the Western Hemisphere can attest, GM crops are not poisonous. In addition, many medicines ingested across the world use the same recombinant gene technology to forge improved vaccines or remedies, yet are not protested in the least. Genetically altered traits are accepted in one substance that humans put into our bodies, but not, apparently, in others. If GM drugs are given a free pass by NGOs because they save lives, from the perspective of a starving farmer in need of higher yields, GM plants could be viewed in a similar light: as a life saver.

But because developed countries have no need to continue increasing yields, GMOs are not seen as solutions to food security issues. As organic foods rise in popularity, genetically engineered plants are viewed as farther from that ideal of ‘natural’ food, and consequently are labeled potentially unhealthy. Many NGOs are vehemently against the introduction of genetically engineered crops, urging a return to organically grown produce, a method which may be more familiar to consumers, but leads to smaller yields (Pardey and Beintema 1996). Larsson, Holmen and Hammarskjold explain the attitude some NGOs have towards agricultural science:

“Another myth about the Africa small peasant farmer that has become influential in the last decades is that ‘small is beautiful’. It emphasizes bottom-up, small-scale, indigenous knowledge...In its milder version, it is a sound reaction against the top-down and sometimes heavy-handed blue-print approaches. In its more extreme versions, this myth becomes an outright rejection of modernity and a far-reaching romanticizing of the life of the peasantry...The mythmakers are often hostile to modern technology, particularly that connected with the Green Revolution. To varying degrees, they have influenced much of the theory and practice in many international NGOs now active in development promotion in sub-Saharan Africa,” (2005:24).

This is not to claim that such ‘mythmakers’ are singlehandedly to blame for the exclusion of GE crops being used in Africa; it is ultimately the responsibility of African government leaders to direct the course of their own agriculture. Still, the disproportionately harsh critique of such valuable technology has done a great disservice to Africa’s hungry. While such a pro-organic attitude will not cause starvation in wealthy nations, in poorer areas that desperately need to increase yields, it will. Paarlberg writes, “In Africa, where farmers struggle with low soil fertility, the last thing they need to be told is to avoid all use of chemical fertilizers,” (2008:101). In spite of this, Germany, Switzerland, Sweden, Belgium, and the Netherlands have all promoted

organic farming techniques in the developing world through their foreign assistance programs, after domestic organic lobbyist groups encouraged them to do so (Ibid). Norway has gone so far as to send inspectors into African ports to help the governments scrutinize imports for any possible GMOs the incoming cargo may contain (Ibid). While organic farming is fine for a nation with plenty of food, it is not the best practice to encourage for a region in dire need of chemical fertilizers.

This is not to demonize Europe; a number of prominent science centers there have embraced GM crops (WHO 2010). In addition, other regions outside the EU are skittish about GMOs. India, which had already approved GM cotton, recently rejected the commercial cultivation of Bt eggplant on the grounds that it does not have an established safety record (BBC 2010). The BBC explains, “Following an uproar from farmers and anti-GM activists, the environment minister held a series of national consultation meetings” (2010:1), after which, Environment Minister Jairam Ramesh was quoted as saying, “Public sentiment is negative. It is my duty to adopt a cautious, precautionary approach...independent studies [are needed to establish] the safety of the product from the point of view of its impact on human health and environment,” (Ibid). Distrust of transgenic crops, it appears, is a worldwide phenomenon.

Unfortunately, African legislators have been swept up in the wave of anti-GMO sentiment: “Governments in Africa have become so wary of agricultural GMOs that only one state on the continent, the Republic of South Africa, has yet made it legal for ordinary farmers to plant such crops. Africa needs new farming science more than any other region, yet it has been the least eager, so far, to embrace modern agricultural biotechnology. *This is a response that reveals considerable ignorance along with opposition, because food products with GM ingredients (mostly corn and soy) have been pervasive in American markets since 1996,*” (Paarlberg 2008:22). This is not to say all Africans are ignorant, whereas all inhabitants of the Western Hemisphere are smart: even within countries that plant vast quantities of GM crops, ignorance regarding such plants still runs high, and approval or disapproval for GM crops tends to coincide with levels of education: “In the United States disapproval is strongest among people over 64 and among people with low education. Americans with post-graduate degrees are among those most likely to approve of GMOs....An identical pattern emerges in Europe,” (Paarlberg 2008:25). Education appears to be a deciding factor.

Some African governments have constructed ‘approval boards’ to determine the safety of GM crops, and claim that once these boards return with proof that they are safe, GMOs will be permitted for commercial growth (Falck-Zepeda, Cavalieri, and Zambrano 2009). However, not only is it impossible to ‘prove’ the absence of something - as any social scientist knows, even one million trials that show something has not caused illness cannot definitively prove it never will - but even if it were, African ministries have shown remarkably little initiative: “The absence of regulatory approval for the commercial use of transgenic varieties (as distinct from

trials) is a major reason why LDCs are lagging behind,” (Pardey and Beintem 1996:19). With so few resources to go around, creating a well-educated GMO safety board is hardly a politician’s priority. Paarlberg writes, “Competent biosafety committees are non-existent in Africa. Because they are unfamiliar [with GM crops]...they are fearful of being criticized for making a mistake when presented with a formal application, then stall, ask for more tests, or make no decision at all,” (2008: 121). The US has even given funds to create more efficient biosafety committees, but this has led nowhere. Hand (2005) notes that the US gave Nigeria over \$2 million in 2004 to develop institutional infrastructure for approving GM crops, and then flew the approval board to Missouri to show them how safe the crops appeared growing in the fields; after returning home, the Nigerian board canceled several meetings, performed no field trials, and then asked USAID for more money. The legislators were more concerned with receiving more money than in forwarding agriculture at home.

USAID’s attempts to convince African legislators that GM crops did not stop there, but continued until recently, when “USAID had grown tired of promoting a technology that governments in Africa apparently didn’t want,” (Paarlberg 2008:175). GE promotion from the western hemisphere is not restricted to state agencies, but extends to philanthropists as well. The Gates Foundation partnered with Monsanto, a large agricultural R&D firm based in St. Louis, Missouri, in an attempt to develop drought tolerant crops. But “finding a government in Africa both willing and able to provide the timely biosafety approvals needed to test and eventually commercialize a new GM variety of drought-tolerant maize remained an uncertainty,” (Sharma 2009). African governments simply do not appear ready to accept GM crops, even if others are willing to shoulder the financial burden. But just as condemning all Europeans for misguided views on GMOs would be wrong, so too would congratulating all American companies and aid agencies for promoting the technology; companies like Monsanto, for instance, stand to gain a large market for their creations if Africa opens up to GMs. Regardless of monetary motivations, however, GM crops would ultimately produce higher yields for small-scale farmers, rendering the motives – be they charitable or financial – less important than the final outcome.

Though a lack of initiative to approve domestic GMO plantings is bad, even worse is the disturbing trend for African governments to reject GMO food aid donated from the developed world. It appears that starvation is preferred to the introduction of this agricultural technology. In 2002, Zambia rejected emergency food aid from the United States during a severe drought, citing British rejection of GMOs as their rationale (BBC 2002); if GMOs are considered dangerous in Europe, Zambia’s government reasoned, they are dangerous for us too. Paarlberg chronicles the events:

“In August 2002 the vice president of Zambia turned down all imports of GM maize, even though nearly 3 million citizens faced a pressing need. Zambian leaders had been importing GM maize as food aid for a number of years, but now they were

refusing it, even in an emergency....Zambian President Levy Mwanawasa commented, ‘Simply because my people are hungry, that is no justification to give them poison, to give them food that is intrinsically dangerous to their health,’” (2008:15).

Mwanawasa’s refusal came in spite of World Food Program (WFP) officials imploring the government to amend its stiff policy (BBC 2002). Zambia’s refusal of GM food aid was hardly an isolated incident in sub-Saharan Africa: “As of 2006, Angola, Malawi, Mozambique, Namibia, Nigeria, Zimbabwe and Sudan had all officially rejected food aid shipments that might contain GM grains, while others, including Zambia, Ghana and Benin had announced explicit bans on the import of all GM foods and crops,” (Paarlberg 2008:17). Fear of possible poisoning overtook fear of starvation, an unusual inclination considering no one has ever died from eating GM crops, yet many millions of Africans have starved to death. In this case, ignorance on the impacts of GMOs was coupled with desire to keep European NGOs and governments happy: “Political leaders in Africa depend heavily upon foreign assistance, and half of all of the foreign aid flowing into Africa comes from the EU. It is thus not surprising to see governments in Africa paying greater attention to the policy preferences of European donors on GMO issues than to the preferences of the US government,” (Paarlberg 2008:124).⁶ Lack of education mixed with political maneuvering by African governments has left farmers there without this valuable tool. A joint book foreword by Norman Borlaug and Jimmy Carter concludes, “The science of genetic engineering has significant potential to help rural Africa, particularly since it can now speed the development of crop varieties better able to tolerate stress factors such as drought. Yet the governments and nongovernmental advocacy groups of most prosperous countries, particularly in Europe, are resisting the introduction of modern agricultural biotechnology in Africa,” (2008:viii). Poor governmental decision making has left an invaluable tool for alleviating hunger on the shelf.

South Africa’s Unique Stand

In the midst of so much anti-GM sentiments within European and African governments, South Africa has bucked the regional trend and encouraged GM crop cultivation. The nation has not merely allowed, but heartily embraced GM crops, beginning in 1997 with GM cotton (ISAAA 2002). Their popularity has skyrocketed, and within five years 45% of cotton grown in South Africa was genetically modified; as of 2007, this figure had risen to 90% (Paarlberg 2008). Other GM crops soon followed suit, with the introduction of Bt white and yellow maize (Falck-Zepeda, Cavalieri, and Zambrano 2009). This breakthrough was a major step toward poverty alleviation, since the introduction of a staple as opposed to a cash GM crop would increase yields for subsistence farmers in addition to commercial growers: “Both large-scale and small-scale farmers enjoy financial benefits due to higher yields and despite higher seed costs. In addition, those who adopted the technology appear to be more technically efficient than those who do not adopt (Gouse, Kirsten and Gouse 2003:1). Net income gains for those using GM crops were

⁶ This is not to criticize only EU countries; the US could be doing more to promote the spread of GM crops as well, but the distinction is drawn in that the US moderately promotes GMOs, whereas European governments and NGOs have a history of attacking their use. This may seem bias coming from an American author, but I am quite critical of my own government’s foreign policy in most cases, so I ask the reader to forgive my nationality.

significant, leading to the rapid spread of GM maize seeds throughout the country (Ibid). Michael Appel details the current status of GM crops in South Africa: “Since the adoption of ‘biotech’, the amount of genetically modified (GM) maize, soya bean and cotton planted in South Africa, in terms of area planted, has increased to 1.8-million hectares... The most popular GM trait in South Africa is Bt insect resistant maize, with 1.1-million hectares planted, followed by RR herbicide tolerant maize, with 373,000 hectares planted. Stacked traits Bt+RR sales commenced in 2007 and 80,000 hectares have been planted to date,” (2008:1). With recent data showing over 50% of maize in South Africa being genetically modified, President of agricultural R&D firm Agri-SA Lourie Bosman claims “the increase [in] the figures are indicative of the increasing confidence thousands of South Africans and emerging farmers have in crop biotechnology,” (Ibid). The government is satisfied with the gains achieved from GM crops, and is currently conducting field trials for a new strain of drought-resistant maize which is projected to be ready for commercial growth by 2011 (Ibid). Clearly, the public image of GMOs in South Africa is quite different than in much of the rest of Africa and Europe.

South Africa’s welcoming attitude results from a comparatively early introduction to GM crops; before Europe grew wary of genetically altered agriculture in the late 1990s, South Africa had already approved their commercial use and created an institutional framework to regulate and monitor the effects of such crops (Paarlberg 2008). The country’s temperate zone climate had made it an attractive place for international biotechnology firms to run field trials, and as such the government grew accustomed to their presence and became comfortable with their safety record (Falck-Zepeda, Cavalieri, and Zambrano 2009). Paarlberg chronicles the events:

“Field trials of GM cotton plants began in South Africa in 1989, and commercial production of both GM cotton and maize was approved in 1997. South Africa therefore had its own regulatory policies and its own tested and approved GM crops already in the field a year before the 1998 EU moratorium on approvals for GMOs...and five years before the inflammatory NGO campaigns conducted at the 2002 WSSD in Johannesburg...The campaign had only limited impact, however, because South Africa’s large commercial farmers – still mostly white – were by then already planting GM seeds profitably and with no apparent ill effects either to human health or the environment. In addition, since private industry stood to gain significant profits from commercial seed sales in South Africa, they fought back against [NGOs],” (2008:147).

But certain critics are not satisfied with South Africa’s acceptance transgenic crops. Some contend that South Africa’s laws regulating GMOs do not do enough to protect consumers from possible risks. Mariam Mayet of Biowatch, an anti-GMO NGO, writes of South Africa’s 1997 policy, “Compared, in particular, to a number of international biosafety regimes, the GMO Act has serious shortcomings. It does not, in its present form, constitute an adequate biosafety regime that ensures GMOs are appropriate and do not cause harm to the environment, or to human and animal health,” (2010:1). While Mayet is certainly correct that South Africa’s 1997 GMO Act does not restrict GE crops to the same degree as neighboring countries, she fails to mention that 1) South African legislator’s had no documented reports of sickness to justify tighter regulations; and 2) related versions of these GMOs exist in wealthier countries with well-respected

agricultural approval boards, such as the United States or Argentina. Even if South Africa's health monitors missed something, it is likely that similar issues would arise in other countries, where they would be caught. South Africa is not the only country in the world consuming GM crops.

GMOs and Political Theory

In stark contrast to the rest of the continent, South Africa has jumped on board with this relatively young agricultural technology, and small and large farmers alike are reaping the benefits. The fact GMOs are accepted or rejected in different African nations fits in with both Decision Making and Pluralist theory. In step with Decision Making theory, governments have decided which course of action best promotes their power and pocketbooks. For most Africa nations, governments have found that keeping their GMO regulations in tune with those of Europe is the best way to ensure continued flows of ODA and stay in the good graces of NGOs who believe GE crops present health hazards. At the same time, they avoid an unknown varietal in which they have no confidence, rightly or wrongly. As GE crops have never been planted in most of these African nations in the first place, administrations do not face pulling a well-liked crop off the market; voters and farmers will simply not know what they are missing. This leads to little, if any, political fallout. South African citizens, on the other hand, already enjoyed higher yields from GE crops for several years prior to European governments' and NGOs' public renunciation of such technology. In spite of pleas to restrict the planting of these crops, it was too late; if the South African government suddenly outlawed such a popular seed varietal, the political repercussions to the administration would have been severe. Taking a resource away is far more dangerous to a politician than never allowing it to enter in the first place, and that distinguishes the treatment of GMOs in South Africa and the rest of the African continent.

Pluralism comes into play when different interest groups petition the government to legislate in a particular way, and that bargaining certainly surfaced during GMO debates. Rich farmers in South Africa were able to convince the government to allow continued plantings of GE crops despite intense opposition from wealthy outside influences. Angering wealthy donors who live far away appears to be preferable to angering rich citizens at home. The result of this battle happens to be positive for subsistence farmers in South Africa, who benefit alongside their politically powerful counterparts (Appel 2008). Because no such lobbying groups of wealthy GMO farmers exist in other African nations, no one is there to petition for their approval. The only powerful voice taken into consideration by these governments is that of aid donors. This demonstrates that administrations weigh the preferences of competing interest groups before determining a course of action.

Transgenic crops have the ability to significantly increase yields across sub-Saharan Africa only if they are allowed to do so. Of course, just like any other agricultural science, in order to achieve its full potential GMOs must be paired with other agricultural improvements like fertilizer, sound infrastructure, secure market access, extension services, irrigation schemes, and so on. These are not insurmountable tasks if only governments muster the political will to make agricultural growth a priority. Lack of understanding on the important role agricultural research

and development plays in nationwide economic growth, and lack of understanding on GMOs in particular, has erected roadblocks to reaching this goal. Waldo writes of NARS, “What is perceived is bureaucratic empire-building on the part of directors [who are political appointments], who are not themselves scientists, and whose chief interest is personal gain or political influence,” (1968:415). With politicians at the helm, the treatment of agricultural research and development – and consequently of GM crops – will be a result of political realities rather than developmental needs.

Solutions to Underfunded Agricultural R&D

Because the support for agricultural science hinges upon politics, and there is no reason to believe that subsistence farmers in sub-Saharan Africa will suddenly increase their political power, it may appear that agricultural R&D geared toward the poor is doomed to remain a low priority for governments. Yet, as events over the past few years have demonstrated, this is not entirely the case. What has contributed to the progress in funding for the agricultural sector in some African nations, and how can this be translated into sustained increases in support for agricultural research and development?

Publicity

As mentioned before, one of the most important factors contributing to the increase in support for agriculture has been the sector’s high profile of late. Historically, as Jack Shepherd writes in reference to Ethiopia, food issues have been considered “low politics”, whereas governments are more concerned with areas of “high politics”, which are “highly visible political and military issues,” (1975:83). Visibility of an issue is quite important if politicians are to focus upon it. Publicity is key: “To mobilize political support for better use of public expenditures in agriculture, an initial step is greater public disclosure and transparency of budget allocation, and analysis of impacts,” (IBRD 2009:11). If the public is aware of the government’s agricultural spending habits and consequences of their allocation decisions, it is more likely to pressure politicians to increase agricultural expenditure. Starting with the Maputo conference in 2003 and continuing as world food prices grew higher, agriculture took center stage; leaders in sub-Saharan Africa were forced to re-evaluate their stance on agriculture as a path towards development and give the sector its due. These events brought increased attention to agriculture. With the highly publicized conference and promises of NEPAD to monitor the progress, African nations faced embarrassment if they did not attempt to live up to their pledges of increasing agricultural budgets. Just a few years later, higher food prices led administrations to view high crop yields as a means of generating cash if enough surplus could be produced for export. While these events influenced governments in different ways, both are examples of a raised profile for agriculture. If politicians are not only aware that agriculture can be used as a tool for developing the nation but are confident that their efforts to promote agriculture will be noticed and appreciated by voters or politically powerful actors such foreign aid donors, there is a far greater likelihood that they will push for agricultural funding. Bates writes, “*The growth of an awareness* that present measures offer few incentives for farmers to play a positive role in the

great transformation may thus provide a foundation for attempts to reform the agricultural policies of the nations of Africa,” (1981:32). The term ‘growth of an awareness’ is crucial; as voters and politicians become more informed and appreciate the power of higher yields, they are more likely to do something about it.

Because publicity is so important, the media plays a critical role in drawing attention to agricultural science. In ‘The Media and Charitable Impulses’ journalist Suzanne Franks writes “Media attention is not merely a fact of power...but for many it may be the difference between life and death. Media power is often critical in the way that aid is allocated. Sensational pictures and stories are pivotal in generating donations. Those disasters and causes that receive the media spotlight are overwhelmed with support – both official and voluntary donations” (Franks 2007). By showing the positive effects of a certain policy, like hungry people receiving aid, or the graphic photographs of the consequences of ignoring hunger issues, such as emaciated citizens, the media provides an invaluable tool which allows the public to hold national governments accountable for their action or inaction. In the case of agriculture, this has been and will continue to be an important factor in determining the way that governments in sub-Saharan Africa handle agricultural science.

Internationally Generated Agricultural R&D

Another solution to increasing the role of agricultural research and development is by moving it out of the hands of national governments and into the domain of international actors. The majority of NARS have not produced acceptable results in creating new agricultural science that poor farmers can use: “Governments have not provided adequate salaries, appropriate incentives, and essential operating funds [for NARS] in a consistent and timely manner...This has resulted in a lack of commitment, frequent disruption of activities, and decreased resource use efficiency; relevance and applicability of research results have been severely affected,” (Ndiritu et al 2004:140). But if agricultural science is considered an international public good rather than one to be controlled by national governments, and treated as such by the UN, then subsistence farmers will not have to wait for their politically calculating legislators to decide when to pay attention to their needs. This would require an increased effort on the part of wealthy nations to fund internationally run research stations such as CGIAR – something much easier said than done, and not likely to happen on a large scale.

Another possible route would be for international donors to take over the funding for nationally-run centers so that agricultural science can proceed regardless of the administration in office: “It is necessary to train many more African scientists to carry out local research. To accomplish training, technology development, and market strengthening, the region’s governments will need long-term assistance from international donors,” (Hanson 2008:1). Improvement in international commitment for agricultural R&D could provide enormous benefits, as these actors have more money at their disposal and are less likely to be influenced by powerful interest groups in sub-Saharan African countries. As the IBRD explains, “Agriculture offers great promise for growth, poverty reduction, and environmental services, but realizing this promise also requires the visible hand of the state...To pursue agriculture for development agendas, global governance for

agriculture needs to be pursued,” (2009:2). While this would be an easy solution if wealthy countries had the will to contribute, generating the motivation in these nations would prove difficult.

It is not only international governing bodies that can make a positive impact on agricultural science, but transnational companies as well. Public-private partnerships (PPPs), in which governments team up with agricultural R&D companies to design technology that can help poor farmers, is one area that could be further exploited. Norman Borlaug and Jimmy Carter write, “Seed companies can help improve access [for rural farmers] by offering preferential pricing for small quantities of biotech seeds to smallholder farmers. Beyond that, PPPs are needed to share research and development costs for ‘pro-poor’ biotechnology,” (2008:ix). Some companies like Monsanto have already joined forces with governments in LDCs and with philanthropic organizations to provide lower cost hybrid seeds and other valuable inputs to subsistence farmers (Paarlberg 2008), but much more could be done on this front.

Tailored Technology

While funding for agricultural R&D would be more consistent in the hands of a supranational governmental body, the actual technology developed needs to be tailored to local conditions. Africa has a heterogeneous landscape that makes a one-size-fits-all solution impossible: for example, hybrid seeds that work in the savannas of Tanzania may not be suited to the highlands of Kenya. Even within countries, diverse environmental conditions and topographies make it nearly impossible for a NARS to create technology that can be applied by all small scale farmers across the nation. Perkins writes, “Above all, governments will have to be prepared to be flexible – foregoing the charms of the single, national agricultural plan in favor of the local and the specific. That is the only way to get the best from Africa’s diverse conditions,” (2008). In contrast to the funding, agricultural research and development in practice would help a broader spectrum of subsistence farmers if there was a measure of decentralization, so that researchers could mold their creations to the specific needs of a given climate. Of course, as it stands now, performing research on smaller, localized scales is not realistic economically; it would not be fiscally viable to construct several different NARS centers spread across the country that work on different varieties, as economies of scale would be lost. But a measure of autonomy for NARS to conduct their own research without a centralized authority dictating all R&D has proven helpful: “Those countries where publicly financed agricultural research continues to be managed through a ministerial department as a part of regular civil service, such as Tanzania, Zambia, and Zimbabwe, seem to have fared considerably worse than those that have opted for semi-autonomy, such as Kenya, Uganda and Ethiopia,” (Ndiritu et al 2004:143). Decentralization of research allows centers to explore technologies suited to the specific conditions of a region rather than forcing all NARS in one country to focus on the same objectives.

One solution that has proven helpful to an extent is the creation of regional R&D centers, funded by two or more national governments, where researchers create agricultural technologies that can be used by farmers who grow crops in similar soils, but live across political borders. A seed that

thrives in eastern Zambia, for example, may also flourish in western Malawi. Because these countries share certain topographies, they can also share the costs of producing agricultural knowledge that could benefit farmers from both states.

Keeping the Powerful Content

Finally, in order to make agricultural reform politically feasible, the majority of power players within a country must be content with the policy change. This is not a solution to increasing agricultural R&D support in and of itself, but rather a caveat as to how these solutions must be implemented. If several powerful interest groups feel they are hurt by a change in agricultural policy, they are likely to fight against its implementation; hence, making policy changes acceptable to as many influential individuals and groups as possible is vital to its implementation. Thirtle, van Zyl and Vink write, "Success in increasing agricultural research and development [geared toward] subsistence agriculture will only be achieved if the following two fundamental policy hurdles are overcome: 1) to find an approach that is acceptable to a sufficiently broad spectrum of interest groups; 2) to ensure that such a coalition of interest groups can sustain the momentum to ensure, among others, that there is a sufficient appropriation in the budget to carry out the reforms that are required," (2000:304). In the context of agricultural R&D, this likely translates to leaving alone, or only slightly reducing, the money allocated to cash crop R&D; a push for subsistence crop technology development can only succeed if the money used to fund it does not take away from money allotted to powerful interest groups on a large scale. If agricultural policy has few enemies, no roadblocks prevent it from helping those who need it.

Conclusion

After evaluating the current state of agriculture and agricultural research and development in sub-Saharan Africa, how this sector affects the economy as a whole, how it influences and is influenced by politics, and what needs to be done to increase sustained support for it, several conclusions can be reached:

- Agricultural research and development should be a major focus of agricultural spending, because of its positive long-term effects on crop yields and consequently on food security and poverty reduction. Agricultural R&D leads to the creation of improved seeds, inputs, and knowledge that can be exploited for years to come. Thirty years from now, smallholders can still benefit from drought-tolerant varieties that are created today. Short term solutions like food aid are necessary in emergencies, but should not be the focus of administrations; simply fixing the manifestation of the problem [i.e. starvation] without getting to the root [i.e. inadequate crop yields] will ensure hunger persists year after year. Medium term solutions, such input subsidies, are extremely popular and can translate into significant crop increases when the next harvest arrives, but because they must be renewed year after year subsidies are an expensive solution that may not prove economically sustainable.

-Subsistence agriculture must be targeted, not only cash crop agriculture, when choosing which crops to target for R&D purposes. Otherwise the poor will not benefit, only the rich. In addition, policymakers must recognize the needs of landless rural laborers if they truly want to target the poorest of the poor. This may involve agricultural technology to some extent, but also requires that their needs be addressed in other ways that can more directly benefit them.

- Most governments in sub-Saharan Africa have historically demonstrated a lack of commitment to development as a whole and agricultural development in particular, and instead focused upon gaining economic and political advantages for themselves and their ethnic kinsmen. The shortsighted nation-building by withdrawing European imperialists on the eve of decolonization left many ‘neopatrimonial’ states full of administrators more concerned with maintaining power than with helping the poor. Along with other developmental projects, agricultural research and development was not prioritized by these governments.

- In line with Decision Making Theory, politicians in sub-Saharan Africa governed so as to secure their power; because smallholders are relatively politically powerless, their long-term needs – such as agricultural technologies for subsistence crops – were not addressed. Agricultural research and development has been ignored, and the majority of the funding that *did* come through was geared toward cash crops, which politicians saw as more likely to generate export earnings and to make large scale, commercial, politically powerful farmers more happy.

- In line with Pluralism, it appears that competing interest groups fight for the limited agricultural resources of sub-Saharan African governments. The interest groups most often weighed against one another are rural vs. urban, smallholder vs. commercial farmer, and one ethnic group vs. another.

- Genetically Modified Organisms (GMOs) have demonstrated their potential to vastly increase crop yields without endangering human health or the environment; these seed varieties can contribute to more food and more export revenue for poor farmers if they are allowed to do so. Unfortunately, the political backlash generated by well-meaning but ill-informed NGOs and governmental organizations in Europe has scared the majority of African governments into rejecting this valuable agricultural technology. In addition to their lack of knowledge on the potentials of GM crops, African administrations also hesitate to embrace them for fear of alienating donors who dislike this technology. Only South Africa has yet to exploit this agricultural technology, with Burkina Faso soon to follow.

- Recent increases in attention to the agricultural sector have improved the treatment that sub-Saharan African governments have given this oft-ignored sector. The African Union conference in Maputo in 2003 and the recent spike in global food prices have both contributed to agriculture’s rising profile. If media attention continues to focus on the importance of

agriculture, and agricultural R&D in particular, governments will pay attention, as they will view it as a politically important topic. Increased attention bodes well for subsistence farmers in desperate need of whatever favorable attention they can get from their governments.

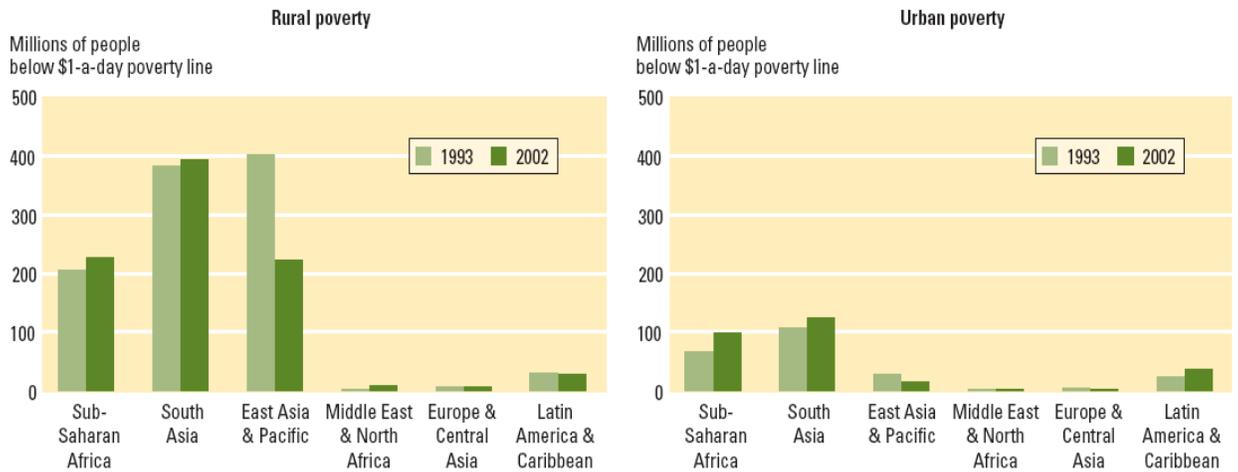
- Solutions for increasing the focus on agricultural research and development include raising the sector's public profile both in the eyes of citizens and governmental leaders; considering agricultural technology an international public good that should be funded by international bodies; generating more Public-Private Partnerships (PPPs); tailoring technologies to local conditions; and ensuring that agricultural R&D policies are appropriate for a broad spectrum of citizens. Though some of these solutions may not be realistic in the near future or are easier to discuss than implement in reality, they are all examples of what has worked so far.

On the whole, agricultural research and development has vast potential to increase the crop yield of poor subsistence farmers in Africa, just as it has improved yields in North America, Europe, and Asia. Higher crop production will decrease malnutrition and starvation, increase market earnings, and in turn bolster the economy nationwide. If African governments demonstrate a commitment to this sector with the long term interest of their countries in mind, agricultural research and development will prove an invaluable tool in lifting these states – and the individuals living within - out of poverty.

Appendix A

Graph Depicting Rise in Absolute Number of sub-Saharan Africans Living on Less Than \$1 a Day, Both Rural and Urban Dwellers 1993-2002

Figure 1 The number of poor has been rising in South Asia and Sub-Saharan Africa from 1993 to 2002 (\$1-a-day poverty line)



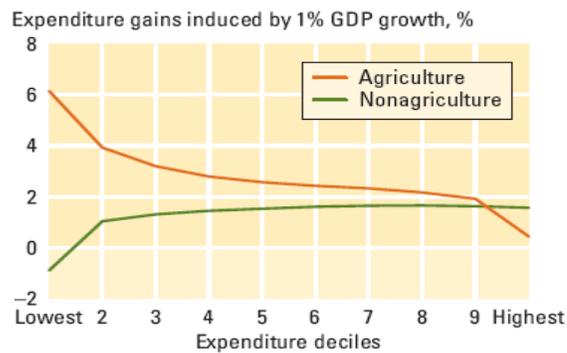
Source: Ravallion, Chen, and Sangraula 2007.

From the World Bank Development Report 2008. Washington DC: International Bank of Reconstruction and Development. Page 14.

Appendix B

Graph depicting how much different deciles of the population gain from agricultural growth; reveals that poor gain the most from GDP growth that originates in agriculture

Figure 3 GDP growth originating in agriculture benefits the poorest half of the population substantially more



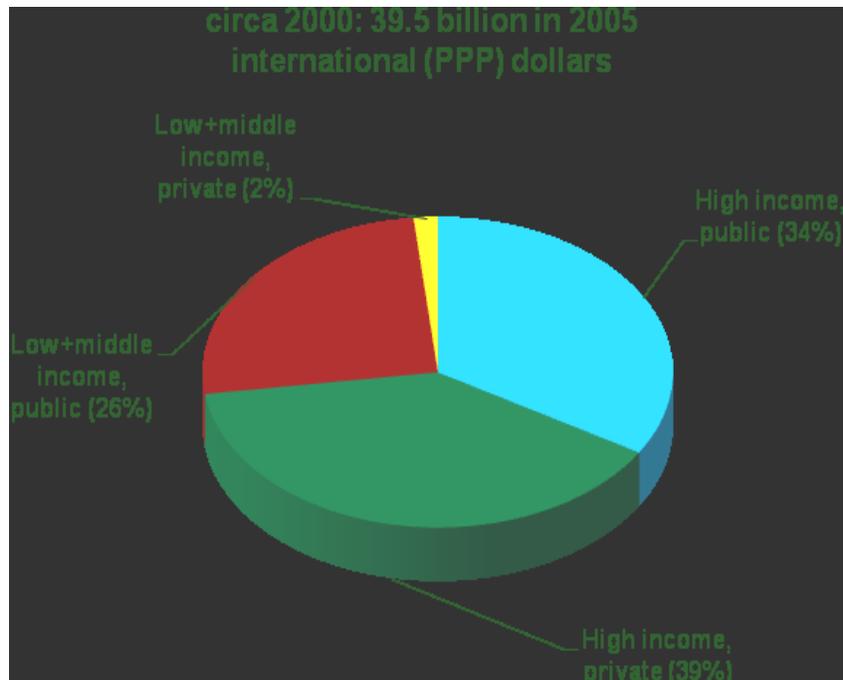
Source: Ligon and Sadoulet 2007.

Note: Based on data from 42 countries during the period 1981–2003. Gains are significantly different for the lower half of expenditure deciles.

From the World Bank Development Report 2008. Washington DC: International Bank of Reconstruction and Development. Page 26.

Appendix C

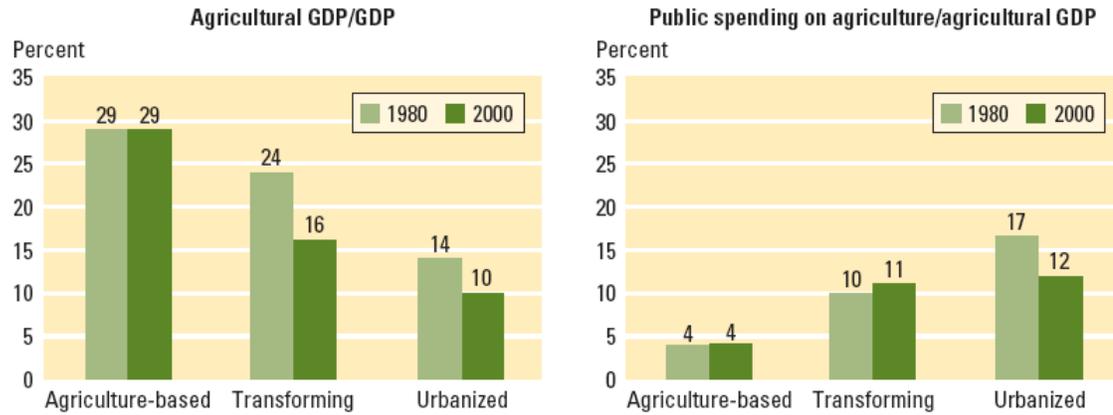
Pie Chart Dividing International Agricultural R&D Expenditures by Type and Wealth of Country of Expenditure



From Measuring Agricultural Research Investments: A Revised Global Picture Nienke M. Beintema and Gert-Jan Stads. ASTI (Agricultural Science and Technology Indicators) October 2008. Page 4.

Appendix D

Figure 4 Public spending on agriculture is lowest in the agriculture-based countries, while their share of agriculture in GDP is highest



Source: Fan, forthcoming.

From Department for International Development. DFID Research Strategy 2008-2013 Working Paper Series: Sustainable Agriculture. Page 11.

Appendix E

Long lags for R&D and technology adoption are typical in agriculture

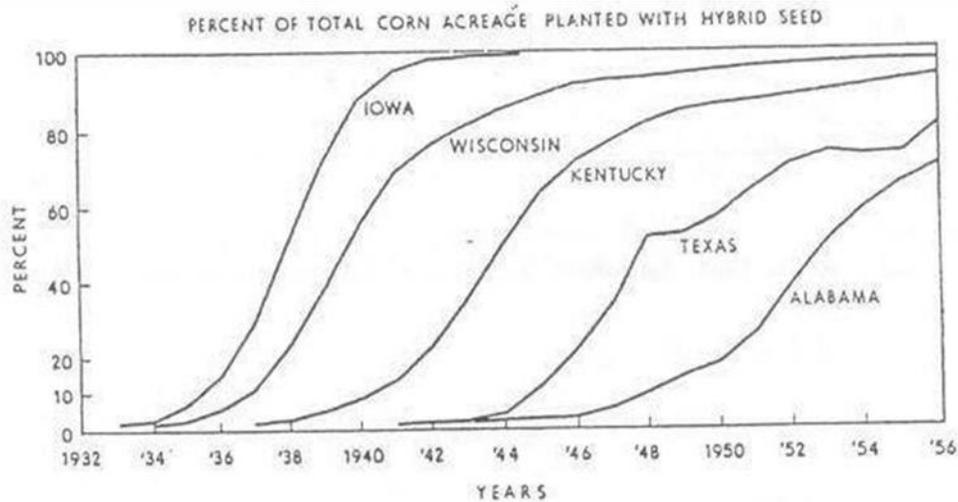


FIGURE 1.—Percentage of Total Corn Acreage Planted with Hybrid Seed.
Source: U.S.D.A., *Agricultural Statistics*, various years.

Reprinted from:
Zvi Griliches (1957), "Hybrid Corn: An Exploration in the Economics of Hybrid Corn."
Econometrica 25(4, Oct.: 501-522.

This graph depicts the long period of time between the development of a new seed varietal and its implementation by farmers in five different American states between 1932 and 1956;

Works Cited

- Aboyade, Ojetunji. (1987). 'Growth Strategies and the Agricultural Sector.' *Accelerating Food Production in sub-Saharan Africa*. Mellor, John, Christopher Delgado and Malcolm Blackie. Baltimore: Johns Hopkins Press.
- Action Against Hunger. (2001) *Geopolitics of Hunger*. Boulder: Lynne Reiner Publishers.
- Agricultural Economics Society of Ethiopia. (1996). 'Sustainable Intensification of Agriculture in Ethiopia'. Proceedings of the 2nd Conference of the Agricultural Economics Society of Ethiopia. Addis Ababa.
- Akande, Tunji et. al. (2005). 'Conclusions and a Look Ahead'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirström, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 253-258.
- Appel, Michael. (2008). 'South Africa Produces More GM Crops.' BuaNews. 28 February 2008. <http://www.southafrica.info/business/trends/newbusiness/gmmaize-280208.htm>. Retrieved 19 March 2010.
- Assembly of the African Union. (2003). Second Ordinary Session. Maputo. 10-12 July 2003. http://www.africaunion.org/Official_documents/Decisions_Declarations/Assembly%20final/Assembly%20%20DECLARATIONS%20%20-%20Maputo%20-%20FINAL5%2008-08-03.pdf. Retrieved 8 February 2010.
- Badiane, Ousame. (2008). 'Sustaining and Accelerating Africa's Agricultural Growth Recovery I the Context of Changing Global Food Prices'. International Food Policy Research Institute. Washington, DC: IFPRI.
- Bates, Robert. (1981). *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*. Berkeley: University of California Press.
- Beintema, Nienke and Gert-Jan Stads. (2008). 'Measuring Agricultural Research Investments: A Revised Global Picture.' Agricultural Science and Technology Indicators (ASTI). October 2008. <http://www.ifpri.org/publication/measuring-agricultural-research-investments>. Retrieved 19 December 2009.
- Bienen, Henry. (1987) 'Domestic Political Considerations for Food Policy.' *Accelerating Food Production in sub-Saharan Africa*. Mellor, John, Christopher Delgado and Malcolm Blackie. Baltimore: Johns Hopkins Press.
- Borlaug, Norman and Jimmy Carter. (2008). 'Foreword'. *Starved for Science: How Biotechnology is Being Kept Out of Africa*. Cambridge: Harvard University Press.

British Broadcasting Company. (2010). 'India Puts on Hold First GM Food Crop on Safety Grounds.' 9 February 2010. London: BBC. http://news.bbc.co.uk/2/hi/south_asia/8506047.stm.

British Broadcasting Company. (2002). 'Africa's Famine.' 11 November 2002. London: BBC. <http://news.bbc.co.uk/2/hi/africa/2027079.stm>. Retrieved 12 March 2010.

Chazan, Naomi, Peter Lewis, Robert Mortimer, Donald Rothchild, and Stephen Stedman. (1999). *Politics and Society in Contemporary Africa*. 3rd edition. Boulder: Lynne Rienner Publishers.

Central Intelligence Agency (CIA). (2009). 'Country Comparison: Life Expectancy at Birth.' Washington, DC. <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2102rank.html>. Retrieved 9 March 2010.

David, Ariel. (2009). 'Economy has left 1 Billion Hungry, UN Says.' *The Boston Globe*. 15 October 2009. Page A8.

Department for International Development. (2008). 'DFID Research Strategy 2008-2013.' Working Paper Series: Sustainable Agriculture. http://www.research4development.info/PDF/Outputs/Consultation/ResearchStrategyWorkingPaperfinal_agriculture_P1.pdf. Retrieved 17 November 2009.

DeReuck, Anthony, Maurice Goldsmith and Julie Knight (eds). (1968). *Decision Making in National Science Policy*. London: Ciba Foundation.

Djurfeldt, G., Hans Holmen, Magnus Jirstrom, and Rolf Larsson (eds). (2005). *The African Food Crisis: Lessons from the Asian Green Revolution*. Cambridge: CABI Publishing.

Djurfeldt, Goran (2005). 'Global Perspectives on Agricultural Development'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirstrom, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 9-24.

Djurfeldt, G and Magnus Jirstrom (2005). 'The Puzzle of the Policy Shift: The Early Green Revolution in India, Indonesia and the Philippines'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirstrom, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 43-64.

Dunleavy, Patrick. (1981). *Democracy, Bureaucracy, and Public Choice*. Hertfordshire: Hemel Hempstead.

Eicher, Carl. (1995). 'Zimbabwe's Maize Based Green Revolution: Preconditions for Replication.' *World Development*. Elsevier Science Ltd. Vol. 23, Issue 5. May 1995. Pages 805-818.

Elster, Jon. (2001) 'Rational Choice and the Explanation of Social Action'. *Philosophies of Social Science: The Classic and Contemporary Readings*. Philadelphia: Open University Press. Pages 448-455.

Falck-Zepeda, Jose, Anthony Cavalieri, and Patricia Zambrano. (2009). 'Delivering Genetically Engineered Crops to Poor Farmers: Recommendation for Improved Biosafety Regulations in Developing Countries.' IFPRI Policy Brief 13. December 2009.

Farrington, John. (1991). *Agricultural Research and the Rural Poor*. Ottawa: International Development Research Center.

Fink, Arlene. (2010). *Conducting Research Literature Reviews: From the Internet to Paper*. Third Edition. London: Sage Publications.

Flick, Uwe. (2006). *An Introduction to Qualitative Research*. Third edition. London: Sage Publication.

Franks, Suzanne. (2007). 'The Media and the Charitable Impulse'. *Political Quarterly* Vol 78. No 4. Blackwell Publishing.

Garfinkel, Harold. (1960) 'Rational Properties of Scientific and Common-Sense Activities'. *Philosophies of Social Science: The Classic and Contemporary Readings*. Philadelphia: Open University Press. Pages 194-201.

Gebre, Takele. 'Sustainable Intensification of Agriculture in Ethiopia'. (2002). Proceeding of the Second Conference of the Agricultural Economics Society of Ethiopia. Addis Ababa, Ethiopia.

Gouse, Marnus, Johann Kirsten and Marthinus Gouse. (2003). 'BT cotton in South Africa: adoption and the impact on farm incomes amongst small-scale and large-scale farmers.' Pretoria: *Agricultural Economics Association of South Africa*.

Grindle, M. (1996). *Challenging the State: Crisis and Innovation in Latin America and Africa*. Cambridge: Cambridge University Press.

Haggblade, Steven (2005). 'From Roller Coasters to Rocket Ships: The Role of Technology in African Agriculture Successes'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirström, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 139-160.

Hall, Martin. (2009). Lecture: Social Explanatory Strategies: Actors, Structures, Processes, and Mechanisms. 16 April 2009.

Hand, Eric. (2005). 'Hungry African Nations Balk at Biotech Cassava'. *St. Louis Post Dispatch*. 29 August 2005.

Hanson, Stephanie. (2008). 'African Agriculture'. Council on Foreign Relations. 28 May 2008. <http://www.cfr.org/publication/16352/>. Retrieved 18 January 2010.

Hetch, Susanna. (1985). 'Environment, Development and Politics: Capital Accumulation and the Livestock Sector in Eastern Amazonia.' *World Development*. Vol. 13, No. 6. London: Pergamon Press. Pages 663-684.

Holmén, Hans. (2005). 'Spurts in Production – Africa's Limping Green Revolution'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirström, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 65-86.

Holmén, Hans. (2005). 'The State and Agricultural Intensification in Sub-Saharan Africa'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirström, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 87-112.

International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). (2008). 'International Agriculture Assessment Calls for Immediate Radical Changes.' 12 April 2008. Johannesburg. <http://www.africafocus.org/docs09/ag0901.php>. Retrieved 8 January 2010.

The International Bank for Reconstruction and Development. (2008). 'World Bank Development Report 2008'. Washington, D.C. <http://siteresources.worldbank.org/INTWDR2008/Resources/2795087-1192111580172/WDROver2008-ENG.pdf>. Retrieved 10 November 2009.

International Food Policy Research Institute. (2009). 'IFPRI's Strategy for Africa.' <http://www.ifpri.org/sites/default/files/publications/africastrategy.pdf>. Retrieved 4 January 2010.

Johnson, Paul. (2005). 'Pluralist Theory'. A Glossary of Political Economy Terms. Auburn: Auburn University. http://www.auburn.edu/~johnspm/gloss/pluralist_theory Retrieved 10 Feb 2010.

Kabeta Muleya, Benson. (1987) 'Commentaries on Political Considerations, Nationalism, and Development.' *Accelerating Food Production in sub-Saharan Africa*. Mellor, John, Christopher Delgado and Malcolm Blackie. Baltimore: Johns Hopkins Press.

Khatri, Yougesh, and Colin Thirtle. (2000). 'Cointegration and Modelling the Length and Shape of the Research Lag.' *South African Agriculture at the Crossroads: An Empirical Analysis of Efficiency, Technology and Productivity*. Thirtle, C., Johan van Zyl, and Nick Vink (eds). New York: St. Martin's Press.

Kohli, Atul. (2004). *State Directed Development: Political Power and Industrialization in the Global Periphery*. Cambridge: Cambridge University Press.

Kumar, Ranjit. (2005). *Research Methodology*. London: Sage Publications.

Laffont, Jean-Jacques, and Jean Tirole. (1991). 'The Politics of Government Decision-Making: A Theory of Regulatory Capture.' *The Quarterly Journal of Economics*. Vol 102, No 4. Pages 1089-1127. Cambridge: The MIT Press.

Larsson, Rolf (2005). 'Crisis and Potential in Smallholder Food Production – Evidence from Microlevel'. *The African Food Crisis: Lessons from the Asian Green Revolution*. Djurfeldt, G., Hans Holmen, Magnus Jirstrom, and Rolf Larsson (eds). Cambridge: CABI Publishing. Pages 113-138.

Larsson, R., Hans Holmen and Mikael Hammarskjold. (2002). *Agricultural Development in Sub-Saharan Africa*. Afrint Working Paper No 1. Lund.

Liebenberg, F., and Johann Kirsten. (2003). 'Status of Agricultural Research and Development Policy in sub-Saharan Africa.' *The Challenge of Change*. Nieuwoudt, Lieb, and Jan Groenewald. Pietermaritzburg: University of Natal Press.

Lipton, Michael. (1988). 'The Place of Agricultural Research in the Development of sub-Saharan Africa.' *World Development*. Vol 16 No 10. Pages 1231-1257.

Lipton, Michael. (1989). *New Seeds and Poor People*. Baltimore: Johns Hopkins University Press.

Low, Allan. (1986). *Agricultural Development in Southern Africa*. London: James Curry Ltd.

Malton, Peter. (1987) 'The West African Semiarid Tropics'. *Accelerating Food Production in sub-Saharan Africa*. Mellor, John, Christopher Delgado and Malcolm Blackie. Baltimore: Johns Hopkins Press.

Mbola, Bathandwa. (2008). 'Heads of State to Increase Agriculture Investment'. Tshwane: BuaNews. 5 June 2008. <http://allafrica.com/stories/200806060019.html>. Retrieved 9 February 2010.

McKenzie, David and Faith Karimi. 'Annan Urged to Intervene in Kenyan Dispute'. CNN. 16 February 2010. <http://edition.cnn.com/2010/WORLD/africa/02/16/kenya.politics/index.html>. Retrieved 16 February 2010.

Mellor, John, Christopher Delgado and Malcolm Blackie (eds). (1987). *Accelerating Food Production in sub-Saharan Africa*. Baltimore: Johns Hopkins Press.

Miller, David (ed) (1987). *The Blackwell Encyclopedia of Political Thought*. Oxford: Oxford University Press.

Morgan, W.B. and Munton, R. (eds). (1972). *Agricultural Geography*. New York: St. Martin's Press.

Muhereza, Frank E. (2009). 'An Assessment of Key Agricultural Policies to Determine Government of Uganda's Commitment to the 2003 Maputo Declaration.' Revised Final Report. 27 May 2009. Kampala.

Nader, Claire and Zahlan, A. (eds). (2004). *Science and Technology in Developing Countries*. Cambridge: Cambridge University Press.

Ndiritu, C., John Lynam, Adiel Mbabu. (eds). (2004). *Transformation of Agricultural Research Systems in Africa*. East Lansing: Michigan State University Press.

Neergaard, Helle and John Ulhoi. (2007). *Handbook of Qualitative Methods in Entrepreneurship*. Northampton: Edward Elgar Publishing Limited.

NEPAD (2009). 'AGRA and NEPAD Form Historic Partnership to Rapidly Increase Food Production and Achieve Food Security in Africa'. 9 November 2009. Lagos: www.nepad.org/News/sector_id/6/lang/en/news/47. Retrieved 15 May 2010.

Paarlberg, Robert. (2008). *Starved for Science: How Biotechnology is Being Kept Out of Africa*. Cambridge: Harvard University Press.

Pardey, P., Alston, J., Piggott, R. (eds). (2006). *Agricultural R&D in the Developing World: Too Little, Too Late?* Washington, DC: International Food Policy Research Institute.

Pardey, P., and Nienke Beintema. (1996). *Slow Magic: Agricultural R&D a Century After Mendel*. Washington DC: AEI Press.

Perkins, Anne. (2008). 'The Future for Agriculture in Africa.' London: The Guardian. 9 July 2008. <http://www.guardian.co.uk/katine/2008/jul/09/background.livelihoods>. Retrieved 29 January 2010.

Pollack, Andrew. (2010). 'Study Finds Benefits in Modified Crops But Warns of Overuse'. *The New York Times*. 14 April 2010. Page B3.

Potter, Jonathan (1996). *Representing Reality – Discourse, Rhetoric and Social Construction*. London: Sage Publication.

Research and Development: Proceedings from a Conference Held at Bunda College in Lilongwe, Malawi. 6-10 April 1992.

Roseboom, J., Philip Pardey and Helmke Sarorius von Back and Johan van Zyl. (2000). 'The Public Agricultural Research System.' *South African Agriculture at the Crossroads: An*

Empirical Analysis of Efficiency, Technology and Productivity. Thirtle, C., Johan van Zyl, and Nick Vink (eds). New York: St. Martin's Press.

Sharma, Yanja. (2009). 'Gates Foundation Joins Global Crop Research Network'. London: Science and Development Network. 10 December 2009.

Shepherd, Jack (1975). *The Politics of Starvation*. Washington, DC: Carnegie Endowment for International Peace.

Simon, Herbert. (1983). *Reason in Human Affairs*. Stanford: Stanford University Press.

Smil, Vaclav. (2000) *Feeding the World*. Cambridge: MIT Press.

Tannous, Afif. (1969). 'Organizing Science and Technology for Agricultural Development.' From Proceedings of a Conference Held at the American University of Beirut. Lebanon.

Thirtle, Colin, and Robert Townsend. (2000). 'The Returns to Research and Times Series Analysis.' *South African Agriculture at the Crossroads: An Empirical Analysis of Efficiency, Technology and Productivity*. Thirtle, C., Johan van Zyl, and Nick Vink (eds). New York: St. Martin's Press.

Thirtle, C., Johan van Zyl, and Nick Vink (eds). (2000). *South African Agriculture at the Crossroads: An Empirical Analysis of Efficiency, Technology and Productivity*. New York: St. Martin's Press.

Timmer, P. (2005). Agriculture and Pro-Poor Growth: An Asian Perspective. Working Paper Number 63, July 2005, Center for Global Development, Washington D.C.

Viotti, Paul and Mark Kauppi (2001). *International Relations and World Politics: Security, Economy, Identity*. Second Edition. Upper Saddle River: Prentice Hall.

Waldo, Dwight. (1969) 'Planning and Administration for Viable Policies: The Perspectives of Official Responsibility'. From Proceedings of a Conference Held at the American University of Beirut. Lebanon.

Ward, Gordon. (1969). 'Integrating Research, Extension and Co-operatives for Agricultural Development'. From Proceedings of a Conference Held at the American University of Beirut. Lebanon.

Watts, Michael and Thomas Bassett. (1986). 'Politics, the State and Agrarian Development: A Comparative Study of Nigeria and the Ivory Coast.' *Political Geography Quarterly*. Vol 5., Issue 2. April 1986. Pages 103-125.

Wiggins, Steve. (2005). 'Restoring Growth in African Agriculture'. Overseas Development Institute. <http://www.odi.org.uk/resources/download/497.pdf>. Retrieved 12 February 2010.