The Effect Of the 2006 Agricultural Input Subsidy Program on Malawian Agricultural Productivity and General Social Welfare

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ABSTRACT
The role played by the agricultural sector in economic development in sub-Saharan Africa has been contentiously debated. Yet several reforms, be they pro-privatization or government-directed, have failed to demonstrate increases in yield as much as Malawi’s 2006 Subsidy Program. Despite its notoriety for defying the advice of the international community, the program’s specific effects on economic and social development has lacked rigorous statistical analysis. The first part of the paper will set the context for the 2006 program, including past failures of policy, their negative effects on both agricultural and social development, and historical reasons against subsidization. The second part of the paper will involve statistical analysis of agricultural production, comparing yields across several countries before and after the intervention period, as well as assessing the impact of policy on social indicators. The last part of the paper will weigh both the normative and positive conclusions set out by the paper, and determine the “Malawi Model’s” possible implications for the future of development.
The Effect Of the 2006 Agricultural Input Subsidy Program on Malawian Agricultural Productivity and General Social Welfare

The subsidization of industries in sub-Saharan Africa has been contentiously debated since the end of the colonial era. Since the agricultural sector employs the majority of the population in almost all countries in sub-Saharan Africa, it is the industry that draws plenty of attention from scholars across a variety of fields. There are two main arguments that direct policy. The first is to promote increased protectionism and government subsidization of the agricultural industry. The second is to base policy around a free market model, where the global and national market find equilibrium and promote individual empowerment. Both theories have been difficult to support across the board for developing nations in Africa.

Accordingly, the structural adjustment policies of the 1980s in Africa continue to be enforced and critiqued today. They were founded on the idea of keeping governments accountable to their people, while preventing them from overspending to further their political motives. Both of these impetuses were meant to foster social and economic development. However, Africa is still the poorest continent, and has failed to keep up economically with other areas of the developing world. Agricultural exports tend to be weak, despite being the largest sector in most African economies. William Easterly claims that this is actually due to weak enforcement of SAPs. Both governments and IFIs have reneged on their
promises due to their short-term goals of political survival\(^1\). As a result, foreign aid has helped prop up corrupt governments and simply temporarily stave off crises in a reactive nature, rather than proactively promote a nation’s development.

Yet, it may be argued that all governments can be labeled as “corrupt” (least of all the United States’). While many African governments are not wholly accountable to their people, “true” democracies do exist on the continent. Malawi has been democratic since 1994, holding competitive multiparty elections, and has seen two presidents under different parties since political reform. Yet, its decision to go against advice from the IMF and World Bank set it apart from other African governments.

Malawi has often been dubbed “one of the poorest countries on Earth”\(^2\). However, after going against the advice of international donors by subsidizing their agricultural industry, the country enjoyed a prolific period of maize production since 2006 to the present day. While it imported maize in the past from Zimbabwe during times of crisis, it has now turned into a net exporter of food, becoming a major contributor to the World Food Program’s emergency food aid stocks\(^3\). Amidst rising global food prices, it appeared that Malawi instantaneously achieved a self-sufficient food secure economy. This unique

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\(^3\) ibid. pp. 62
turnaround of policy, and its notable effects, has attracted much academic attention due to its paradigm shifting policy of anti-privatization beliefs.

This paper will assess the effects of the 2006 program on Malawi’s agricultural sector as a case study for effective domestically-driven policy. While maize production did increase, it has not been critically studied in the context of other intervening variables. This study will attempt to determine the genuine effects of the program when taking into account several different factors, and the potential role it can have in Malawi’s macroeconomic development.

**Literature Review: Historical Context for the 2006 AISP Program**

Sub-Saharan African nations have long had a reputation of corrupt governments and neo-patrimonialist tendencies. Robert Bates hypothesizes that the failure of the agricultural sector to reach its full potential in SSA is because it is a political arena where governments’ and farmers’ interests conflict⁴. This way of thinking about state-guided policy in Africa still underlies development proposals.

Not so ironically, this “African” trend has colonial origins. When the British established Nyaasaland, now Malawi, they established a centralized agricultural marketing board. As the sole seller and buyer of crops, this parastatal was meant to support smallholder farmers in times of crisis by providing global market access and subsidies as a safety net. Instead, it functioned as a monopsony that bought from producers and sold their commodities on the world market to accrue

While these profits were meant to make their way back to smallholder farmers, they essentially acted as an extra tax stream. Additionally, the British took ownership of the most fertile land and sold these estates to European buyers. This dispossession of land not only robbed smallholders of the most productive land, but also undermined the local chiefs who consorted with the buyers.

Upon independence in 1964, the new government of Malawi carried on this colonial legacy. Under the autocratic leadership of Life President Hastings Kamuzu Banda, the agricultural board was simply another instrument to consolidate his rule. The large European estates transferred hands into the elite of Malawi. As a result, these owners formed an elite class and gained much political sway in favour for their subsidization.

Banda claimed to use profits from smallholder production to support macroeconomic stability. These funds were meant to be used to augment foreign reserves and support the economy in the long run, but were instead used at the smallholders’ expense. While these reserves should have been a buffer against high global market prices, Banda’s government primarily used these funds for urban development. Additionally, agricultural prices were kept low to increase

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5 Ibid. 12
7 Pachai pp. 5
8 Ibid. pp. 7
the real wages of urban workers, in an attempt to attract workers to the cities\(^\text{10}\).

Many African nations desired to catch up with the rest of the worlds’ economies through state-guided industrialization and often viewed agriculture as an obsolete economic sector\(^\text{11}\).

This fear of African neo-patrimonialism is used to justify the policies of the "West" to this day. The state-marketing boards gave government intervention in agriculture of any kind a bad reputation. In addition to being liable to corruption, state-led initiatives are believed to impede free-market development, which under neoclassical economic theory would create the optimum prices for consumers and producers alike, and thus help reduce poverty. Theoretically, it should also equalize exchange rates across sectors, reduce demand for imports and raise foreign exchange earnings\(^\text{12}\). However, the World Bank later repeatedly changed its view on such policy conflicts.

Government-directed agricultural reforms were naturally made in response to other important economic events, such as the oil shock in the 1970s, domestic political and economic factors and structural adjustment programs. Kherallah claims that these interventionist policies were largely offset by the effects of external macroeconomic conditions such as the oil shocks of 1973 and 1979, and African currency overvaluations\(^\text{13}\). African policy makers pointed to the

\(^{10}\) Bates pp. 36


\(^{12}\) Kherallah pp. 20.

\(^{13}\) Ibid. pp. 10
success of African governments trying to directly subsidize small farmers, but in the 1980s, SAPs halted any progress or experimentation. Maize productivity increased most in Zambia, Kenya and Zimbabwe\textsuperscript{14}.

As mentioned, the agricultural estate sector grew at the expense of smallholder farmers under Banda. The market liberalization in the 1980s only favoured the estates even more. While the markets should have attracted workers to earn higher wages at the estates, this policy assumed easy labour access. The reality was that families could not realistically commute to work on the estates on a consistent basis\textsuperscript{15}. The withdrawal of subsidies removed any kind of safety net for smallholders. While a move towards estates may make sense in theory, it fails to account for infrastructural development. Market liberalization was only successful in those nations where infrastructure was well developed\textsuperscript{16}. In these nations, employees could easily commute from their traditional lands to work on the larger estates.

More crucially, SAP policies ignored traditional communal land ownership\textsuperscript{17}. Understandably, families were reluctant to sell the land that had been under family ownership for generations. The Bank did attempt to promote


\textsuperscript{16} Nicholas Minot and Todd Benson “Fertilizer Subsidies in Africa: Are Vouchers the answer?” \textit{IFPRI Issue Brief} No. 60, pp. 3.

the devolution of large estates to smallholders, but again the issue of land ownership made this inefficient\textsuperscript{18}. Additional land ownership would have split up the family, and few families had sufficient credit to expand their land tenure\textsuperscript{19}. Furthermore, as in other nations inside and outside of the continent, kinship is strongly tied to where an individual lives. Thus, farmers leaving their land represented a departure from their familial history and a “rupture of identity”\textsuperscript{20}. Policy assumed a smooth market transition, but failed to take into account these cultural factors that have dictated life in Malawi for generations.

Due to these restrictions, or rather in response to empirically observed failures, the Bank and other donors pushed for an export-driven economy. Nearly all farming in Malawi has been subsistence farming. In Malawi, “maize is life”\textsuperscript{21} as it is the primary staple crop of choice. Malawi’s economy has long been driven by maize production. Yet, in the eyes of donors, African states could use their low-yielding land to produce cash crops, which could raise revenue to import food at low global prices rather than attempt to achieve domestic food security\textsuperscript{22}.

Initially, burley tobacco production was solely reserved for the estates. Since this generated the most agricultural revenue per hectare, the estate owners (be they the Europeans during colonial times or the Malawian elite after

\textsuperscript{18} Pachai pp. 18  
\textsuperscript{19} Ibid.  
\textsuperscript{20} Peters pp. 160  
\textsuperscript{21} Chirwa et al. 2008, 19  
\textsuperscript{22} Kurlatzick pp. 4
independence) had much sway over policy restrictions on smallholder farmers. From 1964, burley tobacco was a sign of patronage in Malawi. Land tenure was highly classist, with greater ownership of land leading to greater social prestige, perpetuated by these added restrictions. Consequently, there was much valid skepticism directed towards the government by the IFIs.

Post-independence, this was one of the main reasons the smallholder sector failed to grow, despite agricultural support from the government. As little as 20% of smallholder profits made its way back from ADMARC (the Malawian agricultural board) back to smallholder farmers. Nevertheless, in 1987 Life President Banda committed himself to promoting domestic maize availability in the name of food security. This led the precedent for the politicization of maize production in Malawi seen even to this day under President Mutharika.

In the adjustment decade of the 80s, the Bank pushed even further for an export-led economy. This policy intended to reduce state neo-patrimonialism and empower smallholder farmers. Given the problems of domestic drought and political instability in Mozambique, Malawi’s main source of imports, the country was short on both food and cash. Like many other sub-Saharan African nations

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24 Peters pp. 163
25 Knausenberger pp. 406
at the time, it turned to the Structural Adjustment Loans provided by the World Bank for economic support. Under these conditionalities, food prices were kept artificially low and burley tobacco cash crop producer prices, through ADMARC, were raised\textsuperscript{28}. In theory, this would make food more available to consumers and increase real and nominal wages across the board. However, with the removal of input subsidization, maize production plummeted\textsuperscript{29}. Maize production is much more reliant on inputs than tobacco, and thus became the less “profitable” crop.

While these market forces promoted an export economy, the shift to burley production made the Malawian economy heavily reliant on exports, leaving it vulnerable to a “Dutch disease” of sorts. The Bank and other international actors favoured this move towards globalization, fitting it in with David Ricardo’s idea of comparative advantage. In other words, if an economy is best suited to produce a certain commodity or provide a certain service, then it should. However, this mentality assumed easy market access for smallholder farmers, when smallholders frequently incurred high costs to gain such access\textsuperscript{30}. Such a move would also make Malawi’s economy, of which agriculture makes up a third of GDP, incredibly sensitive to price and demand fluctuations on the international market\textsuperscript{31}.

The commercialization of agriculture had jarring effects on gender dynamics. Farmland in Malawi is passed down matrilineally, as farming is seen

\textsuperscript{28} Ibid.
\textsuperscript{29} Ibid.
\textsuperscript{30} Chirwa et al. 2008. Pp. 20
\textsuperscript{31} Harrigan pp. 847
traditionally as a “female” occupation. Men marry into families and move to their wives’ land\textsuperscript{32}. As a result, women were culturally and economically tied to their land. This left the men to go out and find floating employment to give additional support to the household\textsuperscript{33}. With the commercialization of agriculture, particularly through the greater emphasis on tobacco production, this placed added stress on gender interactions, and tended to undermine the independence of the female producer. Men assumed the responsibility to trade their family’s produce on the open market. Experience shows that a greater amount of blame has fallen on women when wages are insufficient to promote food security\textsuperscript{34}. This is despite the fact that more of the earnings are procured by the male traders.

The growing of tobacco on a large scale also has severe environmental impacts. A new focus on tobacco promoted agricultural extensification, with a need to increase hectarage. Also, tobacco requires curing in wooden sheds, which are only durable for two years\textsuperscript{35}. With market forces running unrestrained, Malawi had one of the highest rates of deforestation, losing 3% of forest cover a year\textsuperscript{36}. Growing tobacco over the long-term also depletes soils of nitrogen potassium and phosphorus 10-36 times more than standard crops\textsuperscript{37}.

\textsuperscript{32} Peters pp. 165
\textsuperscript{34} Peters pp. 153
\textsuperscript{35} Knausenberger pp. 405.
\textsuperscript{36} Ibid.
\textsuperscript{37} Ibid. 414
Of course, Malawi was not the only producer of tobacco during these SAPs. Different incentives, from a globalized standpoint, failed to align favourably for the Malawian export market when the majority of cigarette manufacturers were based in the United States. Malawi still had to compete with other producers of tobacco from elsewhere. Furthermore, the US actually had legislation that required the cigarette companies to purchase at least 75% of its tobacco from American producers\(^\text{38}\). For an advocate of free markets, the US had, and still has, an unusually high level of protectionism for its farmers.

With a drastic reduction in food production, the Bank eased its conditions on the Malawian government. This was due to observed sharp increases in fertilizer and seed prices. In 1987, with the Bank’s approval, the government reintroduced subsidies to farmers and intervened to raise smallholder prices\(^\text{39}\). The Bank did a complete reversal of its policy and acknowledged that structural constraints, namely poor roads and lack of smallholder credit, hindered a neoclassical supply response to price incentives\(^\text{40}\). Despite (or because of) the sporadic shifting between neoliberal policy and state-directed intervention, GDP growth was only 1.6% annually between 1980 and 1994, about half the growth rate of Malawi’s population\(^\text{41}\).

From 1992-1993, aid was withheld from the Malawian government due to Banda’s suppression of pro-democracy government proposals. Coupled with

\(^{38}\) Knausenberger pp. 413  
^{39}\) Harrigan 2003, pp. 854  
^{40}\) Ibid. pp. 852  
^{41}\) Ibid.
severe droughts from 1992-1994, the economy stagnated significantly. These events produced enough political pressure for Banda’s dictatorial government to yield to a new democratic government.

Ironically, the division between the Bank and the Malawian government widened upon democratization. The new government was formed on the platform to promote food security, and reaffirm maize as Malawi’s primary crop. One of its most crucial policies was its reformation of the agricultural board. ADMARC’s monopsony over smallholders was removed, preventing any more funneling of money towards the bureaucratic elite. However, it did not do away with the parastatal completely. ADMARC would have a crucial role later on.

The Bank heavily criticized the government for “equating maize production with food security.” While the Bank stated in 1995 (with evidence) of the danger that a focus on tobacco would lower maize production and make the economy too reliant on international markets, it completely reversed its position in 1997. Harrigan suggests that this was simply a knee-jerk reaction by the Bank, automatically opposing any government policy that did not follow the Washington Consensus. The more the government tried to be interventionist, the more the Bank staunchly opposed them. The Bank seemed to see policy directions purely as political maneuvers, rather than out of the sole interest of development, writing off the first democratically elected government in Malawi. While no government is

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42 Harrigan 2003, pp. 852
43 Ibid.
44 Ibid. pp. 854
45 Ibid. pp. 856
perfect, this opposition reflected the Bank’s paternalist lack of trust in African governments at the time.

**Literature Review: Recent History and Summary of Similar Studies**

The introduction of free-markets and the reduction of government intervention were meant to reduce debt and develop an open market (but was perhaps belied by a more multinational agenda). After all, the subsidization of American farmers has substantial notoriety. The failure of state-guided policy is frequently blamed on political inefficacy due to the rent-seeking behaviour of African governments. The result was a drastic increase in fertilizer and seed prices. Denning and his colleagues note that fertilizer free-markets were only successful in Kenya where there was a high level of infrastructure and where the people met a certain threshold of financial stability. However, other studies have shown that fertilizer uptake increased in some countries after free-market introduction, while in others it decreased. They conclude that policy largely determines prices, but does not account for market access and other crucial variables to agricultural productivity. Despite having plenty of fertile land, Africa only consumes 1% of the world’s fertilizer.

These policies made a number of assumptions however. First, developed nations did not play by the same rules, and continued to subsidize their

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47 Denning et al. pp. 3
48 Minot pp. 142
49 Denning et al. pp. 2
agricultural industries, both in an attempt to appease lobbying American farmers and reduce a reliance on oil by developing bio-fuel technology\textsuperscript{50}. Second, the policy assumed that each nation would be able to craft the programs to suit their own needs. Yet, more often than not, governments tried so hard to fulfill the conditions placed on them by donors that they could not invest in key areas, such as roads, agricultural training and storage containers. Third, it assumed that the devolution of power from agricultural monopsonies would be a smooth one. This was not the case due to the poor credit access of small-scale farmers and the mismatch of incentives between producers and private traders\textsuperscript{51}.

The first major nationwide subsidy, the Targeted Inputs Program (TIP), was implemented in Malawi in 1999\textsuperscript{52}. This program led the way for later more extensive reforms. The system did improve seed and fertilizer access for select small farmers, but the program encountered several logistical problems, such as market displacement and late and unequal distribution, while exacting heavy costs on the government’s budget\textsuperscript{53}. However, the program did result in an increase in production, and had positive effects on crop sustainability, such as crop diversification, seed spacing and advanced farming techniques\textsuperscript{54}. The majority of smallholders supported such a program. However, the donors, who funded the

\textsuperscript{50} Kurlatzick pp. 9  
\textsuperscript{51} Kherallah et al. pp. 83  
\textsuperscript{52} While the TIP program continued on as late as 2004, a drastic reduction in funding in 2002 gradually limited its reach (Minde and Ldovu 2007).  
\textsuperscript{53} Rowland Chirwa “The Impact of Starter Packs on Sustainable Agriculture in Malawi” Ministry of Agriculture and Food Security. UK August 2000, pp. 40  
\textsuperscript{54} Ibid.
program in conjunction with the government, pulled out due to its inefficiency. Although there were valid criticisms of the program, donors failed to propose a viable alternative, without which populations would have been even more food insecure. Moreover, the costs of food imports and welfare transfers would have been an even greater stress on the budget. These donors were the same donors who opposed reforms 6 years later.

2005 saw the worst drought in Malawi for years. Intense subsistence cultivation, in the absence of fertilizer and rainfall, depleted soil viability. Due to a lack of irrigation systems, agricultural seasons were highly unpredictable based on rainfall patterns. By late November, nearly 5 million were in need of food aid. Tired of the neoliberal policy imposed on Malawi by the IMF, President Mutharika announced he was “tired of begging for food from the West” and started to implement the widespread Agricultural Inputs Subsidy Program. The government distributed seed and fertilizer across the country at one-third of the market price, through a redeemable coupon system. While this program

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57 Harrigan 2005. Pp. 6
58 Denning et al. pp. 1
subsidized both maize and tobacco for smallholders, the rate of tobacco
subsidization was about one-quarter of the rate maize subsidization\textsuperscript{60}.

The government distributed packs through the Village Development
Committees in each of the 28 districts\textsuperscript{61}. The government also appointed ADMARC
as the sole buyer and seller of maize, with fixed prices at which ADMARC bought
and sold the commodities\textsuperscript{62}. This was to avoid hoarding by private traders that
characterized the free market and neglected smallholder farmers during the
adjustment years\textsuperscript{63}.

National maize production doubled after the first year of implementation,
and tripled the year after that. These statistics are critical to food security
analysis, as 97\% of households grow maize, which “accounts for 60\% of total
calorie consumption.”\textsuperscript{64} Production was sufficient to get most families through the
poor harvest months, when rainfall is scarce.

However, Ariga and Jayne present a cautious picture about the efficacy of
such subsidy programs. They found in Kenya, that subsidy systems were often
implemented where there was easy access to commercial fertilizer markets,
primarily the wealthier areas of the country\textsuperscript{65}. Not only did this not reach those

\begin{thebibliography}{99}
\bibitem{60} Chirwa et al. 2008. Pp. 12
\bibitem{61} Denning et al. pp. 5
\bibitem{62} Masina, Lameck "Malawi Donates Surplus Food" \textit{African Business} No. 342 (May 2008) pp. 67
\bibitem{63} Ibid.
\bibitem{64} Denning et al. pp. 1
\bibitem{65} Ariga, J., T. Jayne, and J. Nyoro. 2008. “Trends and Patterns in Fertilizer Use in
Kenya, 1997- 2007.” Working Paper, Egerton University, Tegemeo Institute,
\end{thebibliography}
who needed it most, but it also displaced the market for commercial fertilizer sellers. They assert that frequently, larger commercial farming estates capture the government subsidies at their lower than market price\textsuperscript{66}.

The efficacy of the 2006 AISP program has lacked any robust academic analysis. One study, performed by several notable scholars familiar with Malawi’s agricultural reforms, attempted to quantify the effects of the subsidy program alone with little statistical rigour. The study compared the yields of two clusters of smallholder fields in the Blantyre region of Malawi. Unlike my study, they did not study across time or national borders, but studied fields exposed to the subsidy and control fields that did not receive government support. They found that rainfall accounts for between 25-35\% of production, assuming that the subsidy program was responsible for the remainder of the increase\textsuperscript{67}.

There were many shortcomings to this study. Firstly, it was conducted in the Millennium Development Village of Mwandama, an essential petri dish for development strategies. As a result, other variables may have been introduced that would magnify the effects of the subsidy (such as better access to clean water, educational facilities, etc.) Secondly, their study focuses solely on one village and across two years (pre- and post-intervention). Furthermore, the Blantyre district, in which it was conducted, is the most fertile region of Malawi. They failed to account for varying levels of the subsidy across several districts where soil fertility

\footnotesize{(footnote continued from previous page) Nairobi. pp. 37}

\textsuperscript{66} Ibid. pp. 39
\textsuperscript{67} Denning et al. pp. 5
is not so favourable, and used a very narrowly focused difference in differences model. By excluding less fertile regions of land, and assuming that rainfall was the only relevant control, the study ignored the possibility that there were other intervening variables that would diminish the perceived effect of the subsidy. Third, while Denning's study claims to have a high number of observations in its study (11,000 farming households), in reality it only observes 110 fields.

While the study certainly had its merits, this study will build on their limited analysis by doing a broader time-series experiment, and by using non-policy countries as a baseline of comparison in addition to pre-intervention Malawi as a baseline of comparison. The goal of my analysis will be to assess the long-term success of the program, its positive socio-economic externalities and its applicability to other regions for broader development strategies.

**Research Design: Hypotheses**

The hypotheses this study will test can be summarized as such:

**Table 1: Hypotheses 1 and 2: Efficacy of Subsidy Programs on Production**

| Hypothesis 1 | The 2006 Agricultural Input Subsidy Program had a significant impact on agricultural production, and was a crucial factor in the maize surplus in the
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68 Ibid.
Null Hypothesis 1 | The surplus maize in the post-harvest period was not due to the subsidy program, but in larger part due to favorable climactic conditions and rainfall.
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Hypothesis 2 | The 1999 Starter Pack program had a significant impact on production (albeit a less prominent one than the 2006 FISP program.
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Null Hypothesis 2 | The Starter Pack program had little or no effect on production.
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Regression 1 and Regression 2 Model (used to test both hypotheses) | Yield/production = subsidy(X₁) + rainfall(X₂) + elevation(X₃) + soil(X₄)
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post-intervention harvests.
**Hypothesis 3**

The 2006 AISP program had positive benefits, beyond agriculture, on socio-economic conditions.

**Null Hypothesis 3**

The 2006 AISP program had no significant effects on socio-economic conditions.

**Regression 3 Model**

Socio-Economic Factors = subsidy($X_1$) + rainfall($X_2$) + elevation($X_3$) + soil($X_4$)

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**Research Design: General Design**

My general design is a mixed-effects Equivalent Time-Series Design spanning the pre- and post- reform period of 1999-2011, using a GLS regression. My unit of analysis will be administrative districts in Malawi, Zambia, Mozambique, Tanzania, Angola, Cote D’Ivoire, Burkina Faso, Rwanda, Ghana, Benin, Senegal, Togo and Cameroon for a total of 201 district units of observation. Since the subsidy programs were implemented in Malawi, much of the study will focus on all of the eight Agricultural Administrative Districts (ADDs) in the country. These districts were artificially created by the Ministry of Agriculture, but are composed of the 28 smaller political sub-districts. They aggregate up to the national level, so are inclusive of all nationwide data. Relevant data on maize
production, inputs and other variables are available through the Ministry’s survey and census database.

In another similar analysis, Zambian and Mozambique districts that border Malawi will be compared across regions and across time, in order to more specifically control for other confounding variables and leave only the policy effects of the subsidy subject to analysis. This will consist of 4 different clusters of districts on either side of Malawi’s border\(^{69}\). Since these clusters are geographically very similar, it will help make up for the limitations of my climatic control data. The analysis will include all of the same control variables used in the above multi-district GLS regression.

The dependent variable of the experiment will be maize yield (in tons/km\(^2\)) in the different regions. Variation of production levels, year by year, will be measured in absolute values and compared to a baseline number. The study will use both the data for 2005 as a baseline (the year preceding the AISP implementation) and an average of data for the pre-reform period. Both baselines will be used to avoid selective errors. Since my panel data is unbalanced, comparing averages of the pre-and post-reform periods is also more efficient. The subsidy program was introduced in response to the poor harvest season and low rainfall of 2005, and thus statistics from this year may skew the results. By using the vital statistic of area of maize under crop, the number of smallholder farms, number of farm estates and farm acreage will be comparable. However, through

\(^{69}\) See Appendix for map of district-cluster groups.
the Malawian National Census of Agriculture and Livestock, such statistics are available for analysis, and may indicate where investment is key (for instance only in areas where large estates have been established). For instance, greater seed availability allows for greater spacing and can allow for an increase in fallowing and crop rotation\(^{70}\). Thus, these variables actually provide a front-door path rather than a back-door path.

My dependent variable will also be analyzed using a line graph for Malawi. While data may not be available for all years in all districts, cross-national level statistics can be used for long-term analysis (which includes both the Starter Pack Program of 1999 and the 2006 Agricultural Input Subsidy Program) while ADD level data can be used for more recent analysis from the 2002 drought year to present day.

The 2006 AISP program will be the independent variable of analysis. Each of the ADD districts has various rates of subsidization, and will be regressed against the yield to assess the specific impact of the policy on production. Coupon distribution ranges from 10% in the Shire Valley ADD to 74% in the Mzuzu ADD. In other words, areas with a higher rate of subsidization that show correspondingly higher production rates would support the claim for the state subsidy program (see Hypothesis 1). The other international districts will serve as baseline controls (0% subsidized) against the Malawian districts. The subsidy program variable will also account for other front-door path variables such as

\(^{70}\) Chirwa et al. 2000. pp. 40
input use (fertilizer and seeds), input quality (hybrid seeds as opposed to cheaper Open Pollination Variety seeds) and on-site practical training.

Major backdoor paths will be taken into account through linear regression analysis and through my Equivalent Time-Series Design. Since Malawian farms are essentially devoid of irrigation systems (only 2% of accounted farmland), rainfall is the only other main input that is not accounted for by the subsidy program. Along with rainfall, measurements of elevation and soil composition will be included in the multivariate regression analysis. Other unpredictable and inestimable data will be taken into account with my 3-country comparison, assuming near-identical environmental attributes. Institutional capacity can be overlooked, as the enacting of the policy itself can account for such a difference. The development of similar programs in other Sub-Saharan African nations would warrant a similar study comparing institutional structure across nations. Yet, for this study, the cross-country comparison of similar land areas can lend external validity to the study, and allow it to be relevant to other fertile areas of Sub-Saharan Africa.

The study focuses on maize production since Malawi’s economy (and thus its subsidy program) is heavily focused on the staple crop. All other countries studied have significant maize economies as well, over 50% of GDP71, and thus their inclusion should not significantly detract from any conclusions made by the study. Regression analysis will also look at the effects on employment and

diversification across sectors other than agriculture (85% of the workforce are subsistence farmers in Malawi). These statistics can ascertain whether the subsidy program had a significant effect on the increase in exports and thus contributed to wages of subsistence farmers to enable them to diversify beyond subsistent farming.

Two main periods will be central to the study. In 1999, the Targeted Inputs Program subsidy was introduced, which distributed free fertilizer and seed to various regions across the country for four years, before being axed from the budget for high cost and international opposition. Unlike the 2006 program, it was not based around market forces, and was thus criticized for having high rates of commercial displacement and liability to corrupt practices. Post-2005 data will show the effects of the more refined AISP program. The implementation of the second program is subject to Campbell and Stanley’s “Testing” threat to internal validity, as the first program may have in part contributed to the logistical successes of the subsequent program72.

**Data**

All of my maize production data was obtained online through the FAO’s CountryStat website73. This database compiled data from national estimates conducted by the various Ministries of Agriculture of each nation. The same database provided the total land area (all in km²) that was reserved for maize

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73 See endnotes.
cropping only. I combined these two variables to create a new variable for total annual yield (tons/km\(^2\)). By controlling for the degree to which land was used for maize, I could more accurately determine a GLS-generated linear relationship between environmental controls and crop production (e.g. a country with a large landmass may have a larger production of maize than Malawi despite the same level of rainfall). Outliers with abnormally large yields were ruled out due to endogeneity issues, such as small areas of land.

My experimental independent variable (the percentage of households that received the subsidy in some form) was based on survey data done by the Malawian Ministry of Agriculture and Food Security in 2007\(^{74}\) (NACAL). This survey provided sub-national estimates of the percentage of smallholders who received seed and fertilizer coupons, with a relatively skewed distribution across districts (Table. 1). One concern were back door paths favoring certain districts (i.e. those districts with the most fertile land would be targeted the most by the subsidy programs). Again, controlling for the variable “area designated for maize” helped nullify these effects. Due to the lack of survey data beyond the 2007 census, I used these statistics for all years following the implementation of the 2006 Agricultural Input Subsidy Program.

\(^{74}\) The National Census of Agriculture and Livestock (NACAL) was conducted by the Agriculture Statistics Division of the National Statistical Office (NSO) in collaboration with the Ministry of Agriculture and Food Security (MoAFS) between October 2006 and October 2007.
### TABLE II: Subsidization Rates of Agricultural Development Districts

<table>
<thead>
<tr>
<th>ADD District</th>
<th>Subsidization Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>KARONGA</td>
<td>48</td>
</tr>
<tr>
<td>MZUZU</td>
<td>74</td>
</tr>
<tr>
<td>KASUNGU</td>
<td>68</td>
</tr>
<tr>
<td>SALIMA</td>
<td>28</td>
</tr>
<tr>
<td>LILONGWE</td>
<td>47</td>
</tr>
<tr>
<td>MACHINGA</td>
<td>52</td>
</tr>
<tr>
<td>BLANTYRE</td>
<td>59</td>
</tr>
<tr>
<td>SHIRE VALLEY</td>
<td>10</td>
</tr>
</tbody>
</table>
Map 1: Map of Agricultural Development Districts
There were three statistics that could be used to measure the extent of the subsidy, all taken from the 2007 agricultural census. The first measure was the percentage of households that used the subsidies for composite maize seeds. These seeds can be reused and are less risky, but are lower yielding. The second measure was for the percentage of households that obtained hybrid seeds from the subsidy program. These seeds are higher yielding, yet riskier to use in the event of an off-season due to climate constraints. The last measure, arguably the one that best captures the reach of the AISP program, was the percentage of households that received the coupons in each district. Surprisingly, no districts attempted to sell the coupons (although this statistic may be subject to survey bias), and only one district had less than a 80% usage rate. I combined these two variables (% of households that received the coupon and percentage that used them to buy fertilizer) to get the most accurate measure of the effects of the subsidy.

Rainfall was the most crucial independent control variable. As the subsidy program variable captures the exposure to fertilizers and seed, and there are almost no irrigation systems, rainfall was the next essential input. Annual rainfall data was much more difficult to find across years at a sub-national level. Data was compiled from various government sources, similar to those that provided

75 Denning et al. pp. 3  
76 NACAL Report pp. 42  
agricultural data. Unfortunately, the data for each country was not collected under one database, so the consistency of measurements was a concern.

One encouraging aspect of the rainfall data available was that most measuring stations were located near or at areas of agricultural productivity. The rainfall measures for Tanzania were taken in conjunction with the agricultural estimates\(^78\). As a result, there was no need to aggregate data collected from different nodes in each district, and rain inputs were optimally measured.

Elevation statistics were aggregated through ArcGIS software. Since maize grows better on low even terrain\(^79\), elevation was another suitable control for use in this study. District-wide elevation measurements were averaged through zonal statistics and applied to each unit of analysis. Although these measurements were rather crude, the districts were often small and homogenous enough to not generate inaccurate estimates. GIS files were taken from the CGIAR Consortium for Spatial Information (CGIAR-CSI)\(^80\).

Deriving soil data was somewhat more complicated. Various soil maps were available to access through ArcGIS, such as soil type, soil constraints or degree of soil tillage. In order to best aggregate the different variables affecting soil quality, a more generalized variable was used, named “quality of soil affecting low to moderate levels of inputs”\(^81\).

\(^{78}\) Ibid.
\(^{79}\) Denning et al. pp. 4
\(^{81}\) FAO GeoMapping Database. Accessed February 2012.
The GIS map represented the soil quality ranging from no constraints (0) to very severe constraints (3)\(^2\). By attributing dummy values to each colour representing soil quality and joining it with district border data, an average value was calculated to determine the soil quality of the region (\(\pm0.1\)).

District mapping data was taken from the Global Administrative District Mapping database, developed by the International Rice Research Institute and the University of California, Berkeley\(^3\). These district maps were used for joins with elevation and soil data for all of the regions studied.

**Table III. Summary Statistics of Malawi pre-2006 AISP Intervention**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>38</td>
<td>1.031495</td>
<td>.2944215</td>
<td>.2816902</td>
<td>1.595585</td>
</tr>
<tr>
<td>rainfall</td>
<td>45</td>
<td>1030.956</td>
<td>362.1535</td>
<td>506</td>
<td>1928</td>
</tr>
<tr>
<td>elevation</td>
<td>48</td>
<td>831.625</td>
<td>307.6771</td>
<td>220</td>
<td>1158</td>
</tr>
<tr>
<td>soil</td>
<td>54</td>
<td>.3</td>
<td>.5298629</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>year</td>
<td>54</td>
<td>2002.5</td>
<td>1.723861</td>
<td>2000</td>
<td>2005</td>
</tr>
</tbody>
</table>

---

\(^2\) See Appendix for map of soil quality.

\(^3\) See DIVA GIS.
### Table IV. Summary Statistics of Malawi post-2006 AISP Intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>30</td>
<td>1.907248</td>
<td>.6654895</td>
<td>.5191457</td>
<td>3.070594</td>
</tr>
<tr>
<td>rainfall</td>
<td>17</td>
<td>1130.588</td>
<td>285.2554</td>
<td>553</td>
<td>1671</td>
</tr>
<tr>
<td>elevation</td>
<td>48</td>
<td>831.625</td>
<td>307.6771</td>
<td>220</td>
<td>1158</td>
</tr>
<tr>
<td>soil</td>
<td>54</td>
<td>.3</td>
<td>.5298629</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>year</td>
<td>54</td>
<td>2008.5</td>
<td>1.723861</td>
<td>2006</td>
<td>2011</td>
</tr>
</tbody>
</table>

### Table V. Summary Statistics of Control Countries pre-2006 AISP Intervention

#### Variable | Obs | Mean   | Std. Dev. | Min  | Max    |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>1411</td>
<td>1.19734</td>
<td>.6736001</td>
<td>0</td>
<td>3.903374</td>
</tr>
<tr>
<td>rainfall</td>
<td>391</td>
<td>863.8166</td>
<td>382.2771</td>
<td>13</td>
<td>2380</td>
</tr>
<tr>
<td>elevation</td>
<td>1477</td>
<td>480.1591</td>
<td>456.7821</td>
<td>16</td>
<td>2067</td>
</tr>
<tr>
<td>soil</td>
<td>1528</td>
<td>.7834097</td>
<td>.7136163</td>
<td>0</td>
<td>2.75</td>
</tr>
</tbody>
</table>

### Table VI. Summary Statistics of Control Countries post-2006 AISP Intervention

#### Variable | Obs | Mean   | Std. Dev. | Min  | Max    |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>729</td>
<td>1.170773</td>
<td>.6350786</td>
<td>.0001283</td>
<td>3.606061</td>
</tr>
<tr>
<td>rainfall</td>
<td>204</td>
<td>959.0382</td>
<td>591.8612</td>
<td>0</td>
<td>6005</td>
</tr>
<tr>
<td>elevation</td>
<td>855</td>
<td>417.7099</td>
<td>433.3995</td>
<td>16</td>
<td>2067</td>
</tr>
<tr>
<td>soil</td>
<td>898</td>
<td>.8139198</td>
<td>.7521437</td>
<td>0</td>
<td>2.75</td>
</tr>
</tbody>
</table>
**Results: Shortcomings of the Data**

Based on other studies and statistics, I expected there to be a correlation between all of my independent variables and yield. Instead, none of my independent variables were strongly correlated with the dependent variable, despite all of my data being on the same micro-level scale. Whether my regressions included 483 observations (by collapsing the unbalanced panel data and finding the means of each of the statistics before and after the 2006 reform) or 2534 observations for annual statistics, there were no correlations above 0.30 (Table 2.).

**Table VII. Correlation of Variables in Non-Collapsed Dataset**

<table>
<thead>
<tr>
<th></th>
<th>yield</th>
<th>rainfall</th>
<th>subsidy</th>
<th>post</th>
<th>soil elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rainfall</td>
<td>0.2591</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>subsidy</td>
<td>0.1354</td>
<td>0.0679</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>post</td>
<td>-0.0022</td>
<td>0.1245</td>
<td>0.1696</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>soil</td>
<td>0.0218</td>
<td>0.1151</td>
<td>-0.0799</td>
<td>0.1193</td>
<td>1.0000</td>
</tr>
<tr>
<td>elevation</td>
<td>0.0489</td>
<td>0.0344</td>
<td>0.0825</td>
<td>-0.1499</td>
<td>0.1543</td>
</tr>
</tbody>
</table>

As mentioned earlier in this paper, accurate and consistent measurements of rainfall were difficult to access, and thus can contribute to the low correlation. Additionally, there were only 647 observable measurements of rainfall, which limited the confidence intervals substantially. This shortage of data set-back my 3-Country Analysis.
My subsidy data was also limited. As I only had data for one year, the same statistics were used for multiple years in the intervention years. In districts outside of Malawi, I assumed there to be a 0% subsidy level both pre-intervention and post-intervention. While this may not necessarily be true in countries outside of Malawi, there were no other significant subsidy programs in other sub-Saharan African nations other than those that preceded the Structural Adjustment Programs that were introduced in the 1980s and the limited Zambian credit-based program\textsuperscript{84}. Alternatively, this experiment may be interpreted as a comparison between Malawi’s AISP program and agricultural policy in the other units of analysis. As a result, it is safe to assume a near zero-level degree of subsidies in the other 12 nation states studied.

On the other hand, the low correlation between yield and soil quality and elevation is stupefying. The data was incredibly specific to each district, and each had a standard deviation as large as its own mean (z-scores of .95 and .93 to soil and elevation respectively). This paper assumes that these two environmental variables are irrelevant to yield, when sufficient amounts of inputs are accessible by smallholders, corroborating with previous literature\textsuperscript{85}.

**Results: Multicountry Analysis of the Agricultural Input Subsidy Program**

The analysis of all 201 districts in my 13-country dataset was done in a collapsed fashion. Each observation was split depending on the unit of analysis and the variable “post-reform”. The pre and post-reform statistics were averaged

\textsuperscript{84} Ariga and Jayne pp. 37
\textsuperscript{85} Denning et al. pp. 4
to give a reasonable view of the data without aggregating the data too greatly.

This also helped make up for the missing observations of rainfall in the unbalanced panel dataset.

**Table VIII. Multi-Country GLS Regression of Factors on Yield**

<table>
<thead>
<tr>
<th></th>
<th>(1) yield</th>
<th>(2) yield</th>
<th>(3) yield</th>
<th>(4) yield</th>
<th>(5) yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>subsidy</td>
<td>0.0141***</td>
<td>0.0136***</td>
<td>0.0147***</td>
<td>0.0148***</td>
<td>0.0148***</td>
</tr>
<tr>
<td></td>
<td>(0.00214)</td>
<td>(0.00246)</td>
<td>(0.00263)</td>
<td>(0.00265)</td>
<td>(0.00266)</td>
</tr>
<tr>
<td>rainfall</td>
<td>0.000248*</td>
<td>0.000257*</td>
<td>0.000256*</td>
<td>0.000293*</td>
<td>0.000293*</td>
</tr>
<tr>
<td></td>
<td>(0.000126)</td>
<td>(0.000135)</td>
<td>(0.000139)</td>
<td>(0.000139)</td>
<td></td>
</tr>
<tr>
<td>post</td>
<td>-0.0743</td>
<td>-0.0747</td>
<td>-0.0746</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0583)</td>
<td>(0.0587)</td>
<td>(0.0588)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>soil</td>
<td></td>
<td>0.00892</td>
<td>0.00884</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0876)</td>
<td>(0.0891)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>elevation</td>
<td></td>
<td></td>
<td></td>
<td>-0.00000687</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.000116)</td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>1.155***</td>
<td>0.830***</td>
<td>0.800***</td>
<td>0.794***</td>
<td>0.799***</td>
</tr>
<tr>
<td></td>
<td>(0.0393)</td>
<td>(0.133)</td>
<td>(0.139)</td>
<td>(0.149)</td>
<td>(0.162)</td>
</tr>
<tr>
<td>N</td>
<td>456</td>
<td>160</td>
<td>132</td>
<td>132</td>
<td>132</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

A time-series based GLS regression was done within each unit of analysis, comparing the data of the pre and post reform periods. Given the drought of 2005, as well as the less extensive (albeit pre-existing) Targeted Inputs Program, both the average of the statistics in the 2000-2005 period and the statistics of 2005 were used as a baseline of comparison. Surprisingly, the results reported almost exactly the same coefficients. This suggests that the improvements of the subsidy program on crop production were the same compared to the drought year of 2005 and the subsidized years preceding the drought. This would support “Null
Hypothesis 2”, where the yields observed during the TIP implementation years statistically did not differ from yields during the drought years. This suggests that rainfall was the only relevant factor affecting production.

Where yield was on average 1.19 tons per km², the subsidy accounted for 0.014 tons per km² for each percent of the smallholder population subsidized (the coefficient for the “subsidy” independent variable). Multiplying this regression coefficient by the standard deviation of the subsidy program (7.91) and dividing it by the average yield, we determine the subsidy to have a 9% positive contribution to yield (supporting Hypothesis 1). Substituting 81.2 (the percentage of the population who are small holders\textsuperscript{86}) we see an increase in national production by 94%. The similar results shown by using both baselines demonstrates that the marked increase in production in Malawi was not simply due to the comparison with the 2005 drought season: comparing the post-intervention yields to both the average pre-intervention yields and the 2005 yields show the same results due to the effective controls of rainfall. As such, we can have confidence in the success of the rainfall data controlling for the differences. By doing a similar analysis with the rainfall statistics, we determine that rainfall actually accounts for about 9.87% of yield with an increase in rainfall by one standard deviation (385mm/yr) and a 8% yield increase with an increase of precipitation by 200mm/yr. In the report done by Denning and his colleagues, an increase in rainfall by 200mm/yr (between the drought period and the following year) contributed to a 32% increase.

\textsuperscript{86} NACAL Report pp. 14
While it is hard to make objective judgments based on visual data, both graphs illustrate an increase in production in both the Malawian districts, and the neighbouring Zambian districts. This can be attributed to favourable rainfalls post-2005. However, it is also clear that Malawi’s increase in yield was much more drastic. This inference can be supported by the statistical data above.

Table VIII. Multi-Country Analysis: Quantified Effects of Significant
Independent Variables on Yield

<table>
<thead>
<tr>
<th>Independent Variable (IV)</th>
<th>Coefficient (X)</th>
<th>Standard Deviation (SD)</th>
<th>SD*X</th>
<th>Average Yield (Y)</th>
<th>SD*X/Y</th>
<th>Percent of Increase Due to IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Households Subsidized</td>
<td>0.014</td>
<td>7.42</td>
<td>0.1039</td>
<td>1.17</td>
<td>0.0887</td>
<td>8.87%</td>
</tr>
<tr>
<td>Rainfall (mm/yr)</td>
<td>0.0003</td>
<td>385</td>
<td>0.1155</td>
<td>1.17</td>
<td>0.0987</td>
<td>9.87%</td>
</tr>
</tbody>
</table>

As expected, none of the other control variables were found to have any statistical significance. While hard to believe, the apparent lack of importance of soil quality and elevation may be down to how the yield was calculated. By controlling for the area of maize that a district dedicates its land to, it selectively may filter out less suitable land for growing food crops. However, with reference to previous literature, smallholders cannot easily extend their land tenures. Most land is inherited through their families, and depending on a number of variables (gender, caste, other social determinations and even bad luck) farmers can end up with farmland normally ill-suited for growing crops. As other studies have shown, advanced fertilizers and seeds can overcome these environmental constraints, given a certain threshold of guaranteed rainfall. It is also noteworthy that with or without these control variables, the coefficients for the subsidy and rainfall more or less remain the same (Table VIII).

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87 Peters pp. 159
88 Chirwa et al. 2008, pp. 3
Results: 3-Country Analysis

Since my units of analysis in my multi-country analysis varied from districts in southern Africa to upper-west Africa, I understood the difficulties in controlling for climactic variables in a simple time-series linear regression. The advantages of Denning’s study was that it used two randomized groups (one experimental and one control) that did not differ but for the manipulated variable. However, it did not factor in the differences in policy across country borders, where climate differences would be minimal (especially considering the small land area of Malawi)\(^89\). Even though farming households in the control group did not receive the subsidized inputs, it may have benefited from other spillover effects provided by the national policy (such as improved crop techniques).

In doing a smaller scale regression between districts in Malawi, I attempted to control for these differences in policy. When the independent variable was “percentage of households given the subsidy”, I failed to come up with significant results (P-value = 0.112). Rather than showing no effects, this regression could simply not come up with a strict mathematical relationship between the level of subsidy and production between the districts (most likely due to the small N=22 compared to the larger N=201 in the earlier multi-country analysis).

However, regressing a dummy variable (borderXpost) for the subsidy program against yield showed significant results (P-value= 0.002).

\(^89\) See Appendix for map of district clusters.
Table X. 3-Country Analysis: GLS Regression of Factors on Yield

<table>
<thead>
<tr>
<th></th>
<th>(1) yield</th>
<th>(2) yield</th>
<th>(3) yield</th>
<th>(4) yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>border</td>
<td>0.448</td>
<td>0.0540</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0.180)</td>
<td>(0.106)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>post</td>
<td>0.558**</td>
<td>0.0572</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0.0871)</td>
<td>(0.0839)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>borderXpost</td>
<td>0.788*</td>
<td>0.930**</td>
<td>0.938**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.199)</td>
<td>(0.154)</td>
<td>(0.170)</td>
<td></td>
</tr>
<tr>
<td>rainfall</td>
<td></td>
<td>-0.00106**</td>
<td>-0.00115**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000169)</td>
<td>(0.000193)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>soil</td>
<td>0.0103</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0830)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>elevation</td>
<td>0.000268</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000106)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>0.679*</td>
<td>0.929**</td>
<td>2.041**</td>
<td>1.900**</td>
</tr>
<tr>
<td></td>
<td>(0.161)</td>
<td>(0.123)</td>
<td>(0.279)</td>
<td>(0.318)</td>
</tr>
<tr>
<td>N</td>
<td>22</td>
<td>22</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Note: Border is a dummy variable for Malawi=1, Mozambique and Zambia =0.
Post is a dummy variable where pre-AISP=0 and post-AISP=1.
Tables XI-XIV: Post- AISP Intervention: Summary Statistics of Malawi and Neighbouring Countries Pre- and Post-AISP Intervention:

Table XI: Summary Statistics for Malawi Pre-Intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>7</td>
<td>.983266</td>
<td>.1597085</td>
<td>.7830501</td>
<td>1.264429</td>
</tr>
<tr>
<td>subsidy</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>rainfall</td>
<td>7</td>
<td>996.7286</td>
<td>274.8024</td>
<td>800.1667</td>
<td>1584.5</td>
</tr>
<tr>
<td>elevation</td>
<td>7</td>
<td>856</td>
<td>343.5773</td>
<td>220</td>
<td>1158</td>
</tr>
<tr>
<td>soil</td>
<td>7</td>
<td>.3857143</td>
<td>.612178</td>
<td>0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table XII: Summary Statistics for Malawi Post-Intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>7</td>
<td>1.828064</td>
<td>.531312</td>
<td>.7714295</td>
<td>2.312977</td>
</tr>
<tr>
<td>subsidy</td>
<td>7</td>
<td>54.28571</td>
<td>19.1221</td>
<td>16</td>
<td>76</td>
</tr>
<tr>
<td>rainfall</td>
<td>7</td>
<td>1077.286</td>
<td>225.9474</td>
<td>851.5</td>
<td>1547.5</td>
</tr>
<tr>
<td>elevation</td>
<td>7</td>
<td>856</td>
<td>343.5773</td>
<td>220</td>
<td>1158</td>
</tr>
<tr>
<td>soil</td>
<td>7</td>
<td>.3857143</td>
<td>.612178</td>
<td>0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table XIII: Summary Statistics for Neighbours Pre-Intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>4</td>
<td>.9292729</td>
<td>.234314</td>
<td>.6980797</td>
<td>1.221748</td>
</tr>
<tr>
<td>subsidy</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>rainfall</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>elevation</td>
<td>4</td>
<td>604.25</td>
<td>230.8136</td>
<td>298</td>
<td>857</td>
</tr>
<tr>
<td>soil</td>
<td>4</td>
<td>1.05</td>
<td>.5259911</td>
<td>.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table XIV: Summary Statistics for Neighbours Post-Intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield</td>
<td>4</td>
<td>.9864281</td>
<td>.2940014</td>
<td>.7463155</td>
<td>1.415214</td>
</tr>
<tr>
<td>subsidy</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>rainfall</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>elevation</td>
<td>4</td>
<td>604.25</td>
<td>230.8136</td>
<td>298</td>
<td>857</td>
</tr>
<tr>
<td>soil</td>
<td>4</td>
<td>1.05</td>
<td>.5259911</td>
<td>.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
The regression shows that growing crops in Malawi or growing crops before or after the intervention period has no significant effect on production. However, it does show that growing crops in the post-intervention period in Malawi significantly increases production. By substituting the standard deviation of the subsidy dummy variable into the linear regression equation (.476*0.787), we see that, on average, it contributes to a 30% increase in production. While this regression did not realistically determine a concrete qualitative relationship between the level of the subsidy program and yield, it did come to the same conclusions as the multi-country analysis and Denning’s analysis: the subsidy program has significant positive effects on production.

Table XV. 3-Country Analysis: Effect of Malawi AISP (BorderXPost) on Yield

<table>
<thead>
<tr>
<th>Independent Variable (IV)</th>
<th>Coefficient (X)</th>
<th>Standard Deviation (SD)</th>
<th>SD*X</th>
<th>Average Yield (Y)</th>
<th>SD*X/Y</th>
<th>Percent of Increase Due to IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>BorderXPost</td>
<td>0.787</td>
<td>0.476</td>
<td>0.375</td>
<td>1.24</td>
<td>0.302</td>
<td>30.20%</td>
</tr>
</tbody>
</table>

*Note: Rainfall, border, post, elevation and soil were all insignificant (Table X.).

Results III: Effect on Social Indicators and Public Opinion

While an increase in maize production is notable, this study intends to look at the positive externalities of the Agricultural Inputs Subsidy Program on development in general. By studying the effects of the subsidy on people’s food security, cash income, view of the national economy, view of their own well-being, view of national economic policy and support of the president, we can determine
the broader effects of the subsidy policy. Naturally, this data is more liable to survey bias.
### Table XVI: Quantitative Effects of the Subsidy on Socio-Economic Variables

<table>
<thead>
<tr>
<th>Dependent Variable (DV)</th>
<th>Coefficient of Subsidy Effects (X)</th>
<th>Standard Deviation of Subsidy (SD)</th>
<th>SD*X</th>
<th>Average Value of DV(Y)</th>
<th>SD*X/(Y)</th>
<th>Percent of Increase Due to Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Security</td>
<td>-0.00716</td>
<td>29.9</td>
<td>-0.214</td>
<td>1.62</td>
<td>-0.13209877</td>
<td>-13.20%</td>
</tr>
<tr>
<td>Income</td>
<td>-0.0051</td>
<td>29.9</td>
<td>-0.152</td>
<td>2.37</td>
<td>-0.06413502</td>
<td>-6.40%</td>
</tr>
<tr>
<td>Economic Policy</td>
<td>0.0139</td>
<td>29.9</td>
<td>0.415</td>
<td>2.35</td>
<td>0.17659574</td>
<td>17.70%</td>
</tr>
<tr>
<td>State's Welfare</td>
<td>0.0143</td>
<td>29.9</td>
<td>0.427</td>
<td>2.31</td>
<td>0.18484848</td>
<td>18.40%</td>
</tr>
<tr>
<td>Personal Welfare</td>
<td>0.019</td>
<td>29.9</td>
<td>0.568</td>
<td>2.63</td>
<td>0.21596958</td>
<td>21.60%</td>
</tr>
<tr>
<td>Employment</td>
<td>0.00361</td>
<td>29.9</td>
<td>0.108</td>
<td>0.634</td>
<td>0.170347</td>
<td>17.03%</td>
</tr>
</tbody>
</table>

### Table XVII: GLS Regression of Subsidy Levels on Socio-Economic Variables

<table>
<thead>
<tr>
<th></th>
<th>(1) food</th>
<th>(2) cash</th>
<th>(3) econ</th>
<th>(4) natecon</th>
<th>(5) persecon</th>
<th>(6) pres</th>
<th>(7) employ</th>
</tr>
</thead>
<tbody>
<tr>
<td>subsidy</td>
<td>-0.00716***</td>
<td>-0.00510**</td>
<td>0.0139***</td>
<td>0.0143***</td>
<td>0.0190***</td>
<td>0.000759</td>
<td>0.00361*</td>
</tr>
<tr>
<td>_cons</td>
<td>1.817***</td>
<td>2.512***</td>
<td>1.970***</td>
<td>1.920***</td>
<td>2.108***</td>
<td>2.543***</td>
<td>0.538***</td>
</tr>
</tbody>
</table>

N: 52  52  52  52  52  52  52  52  50

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Across the board, the subsidy program had positive effects of respondents’ outlook, with the exception of trust in President Mutharika (which yielded no significant results). This analysis illustrates that a higher rate of subsidization generally tends to improve people’s access to food and cash income. When factoring in the standard deviation of the program across districts, we see that people’s incidence of food and cash shortage decreases by 13.2% and 6.4% respectively. The program also improved people’s view of the government’s interventionist economic policy, the health of the national economy and their own financial security (see Table XVI). While all five regressions are subject to survey bias, the first two analyses are most likely to be objective. Thus, it can be said with confidence that the subsidy program positively influenced cash income and food security.

**Conclusion**

Based on my results, it is undeniable that the 2006 AISP played an integral part in the massive surplus of maize production enjoyed in recent years. This study refutes the claim that the increase in production was simply a "regression to the mean" after the strain on agriculture due to the 2005 drought. According to my multi-country regression, reaching all 81% of the smallholders in Malawi would nearly double yield (Table. IX), an even larger effect than that shown by Denning et al. This explains the continued success of the program combined with

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90 Note that for food security and income the data is taken from a survey question “How long have you gone without cash/income?”, hence the negative effect the subsidy has on the value of the dependent variable.
good rainfall. In 2009, the Malawian government estimated that 12% of the population rose above the poverty line since the introduction of the 2006 program. The main critique by observers is the sustainability of the program. The initial program cost the government $60 million USD, but is capable of generating benefit:cost ratios between 0.76 and 1.36. With further improvements to the model, as well as extending its reach to as many low-income farmers as possible, costs have only risen even higher. This model of development also leaves it incredibly sensitive to global fertilizer and maize prices. Should prices spike or plummet, the costs may drastically outweigh the benefits.

As such, international financial support and investment is crucial. Yet, only 9% of World Bank loans go towards agriculture. Considering how important agriculture is to most developing countries, and the vast proportion of subsistent farmers in these countries, donors should possibly think about promoting the adoption (and adaptation) of the “Malawi Model”.

Another problem that subsidies pose is the skewing of the free market. While the subsidy may support the purchase of inputs, it may create a “tragedy of the commons” situation where less vulnerable farmers hoard fertilizer when prices are low, driving up prices for other farmers later on. While the program is meant to target the “poorest” farmers, this market skew may alter the definition of.

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91 Ernest Harsch “Investing in Africa’s Farms and Its Future”, *Africa Renewal*, April 2011 pp.10
92 Kurlatzick pp. 60
93 Chirwa et al. 2008 pp. 1
94 Kurlatzick pp. 63
who needs the subsidy the most. On the other hand, rather than replacing the role of the private trader, government intervention can provide sufficient competition to break the monopoly by private traders and give them the incentives to build a fairer market for smallholders.

Additionally, a government-directed subsidy program, such as this one, is more likely to support farmers on the land that they already have, and have had for generations. Considering the disruptions to social structure referenced earlier in this paper, the adoption of a free market-based model may not have the same positive effects on production that the AISP program had (at least not yet). Communities need time to develop and adapt to an economy where different sectors must coexist. Economic policy cannot be made without consideration of social interactions. Rather than denying people individual economic freedom, government support through the subsidy program can allow smallholders to better make decisions beyond agriculture. Amartya Sen famously wrote about government intervention enhancing an individual’s “positive freedom”, rather than imposing a “negative freedom”\(^95\).

Of course, as my results have demonstrated, the presence of a subsidy program is not enough to guarantee success. The Targeted Inputs Program, which preceded the 2006 AISP program, failed to make a significant increase in agricultural production\(^96\). Yet, the TIP program was critical in helping policy-

\(^{96}\) Comparing my post-AISP results to the TIP yields and 2005 drought yields, surprisingly, made no difference.
makers design its much more effective successor. Donor governments and agencies should not use one failure to condemn future projects, particularly in the interest of serving their own political and economic desires. Malawi suffers from fewer climate constraints than most other African nations, so the same program cannot be implemented everywhere. Climate, population density, level of infrastructure and government centralization will all determine the specific design of other programs. To replicate the success of Malawi, other countries in Sub-Saharan Africa will similarly have to craft programs through trial and error.

Of course, even Malawi’s program can be further improved upon. Other proposals towards agricultural supports include the building of irrigation systems. Both my study and the study done by Denning and his colleagues indicate that rainfall (or irrigation inputs) play a significant role in agricultural yields. Due to the uncontrollable variability of rainfall, a government-led push for the development of irrigation systems may be another avenue towards promoting food security. However, neither study has shown whether rainfall or subsidies (in the form of fertilizer and seed inputs and education programs) has a greater quantitative impact on smallholder yields.

However, providing fertilizer and seed inputs is clearly the most practical form of government support for the agricultural sector. First, developing widespread irrigation systems would be a logistical nightmare. Second, during years of sufficient rainfall, these irrigation systems would be redundant. Third, these systems would require long-term maintenance, demanding further
government involvement. While the subsidy program also poses the problem of long-term government intervention, based on the qualitative data it has proven to have a positive benefit on income (Table. XVI).

Another step the government can take capitalizing on the emerging communications network across the continent. The use of mobile phone technology has been one of the greatest successes of African entrepreneurship. Such technology can be useful to farmers in determining real-time prices for their crops, and reduce the reliance on inefficient middlemen. Of course, this kind of investment will pose benefits well beyond agriculture.

The IFIs and other international agencies can play the role of monitoring these agricultural systems. While allowing regional governments to direct their own national policy, they should ensure that political leaders are not simply introducing a program to boost political appeal. As this paper has pointed out, the politicization of maize, in part, contributed to Mutharika’s advocacy of the 2006 AISP program. Mutharika may have been partially guided by altruistic intentions, but has not had the best anti-corruption track record in the past\(^\text{97}\).

For all its shortcomings, the AISP program can help farmers buffer against shocks and customize their farming practices to suit the local conditions. For example, by improving access to more advanced and expensive inputs, such as the riskier but higher yielding OPV seeds, farmers can prepare for favorable rainfall

\[^{97}\text{Reportedly during Malawi’s economic crisis, Mutharika spent millions of dollars on a private jet.}\]
conditions by using the high yield seeds and increase overall production. The
government also provided, on a limited scale, post-harvest storage bins in the
2008/09 subsidy program\textsuperscript{98}. Such policy espouses Sen’s “Positive Freedom”\textsuperscript{99}
argument where other strategies simply do not. In times of crisis, be they
droughts or external price spikes, market forces acting through private traders
simply cannot cope with such a shock to a developing economy.

Future studies on this topic could build on my analysis, and hopefully come
to even more applicable conclusions. One shortcoming of my study was the lack of
microscopic data. Ideally, I would have studied the yields of several clusters of
two villages on either side of the border of Malawi in the same time period. My
rainfall data was not only sparse, but lacked specificity. Rainfall is most crucial
during the germination of the maize seeds, and can have a significant effect on
production\textsuperscript{100}. As such, it is very difficult to measure and compare the effects of
ideal rainfall conditions and the subsidization of inputs. While neither of these
constraints severely affected my analysis, had I more time and resources to collect
such data, my conclusions would be even more robust. Hopefully, a future study
can, with hindsight, better judge the program’s gradual macroeconomic effects.

Another future study could include an analysis of subsidizing cash crops in
conjunction with staple crops. Tobacco production helps improve food security
for subsistent farmers by allowing them to purchase additional maize when they

\textsuperscript{98} Denning et al. pp. 9
\textsuperscript{99} Sen pp. 18
\textsuperscript{100} Ibid.
could not procure enough food from their own harvest. It is also beneficial for crop diversification, which is better for land cultivation in the long term and promoting growth of staple crops as well\textsuperscript{101}. Farmers could also have greater real wages to purchase commercial items and non-maize food products.

The real question remains: can similar subsidy programs significantly alleviate extreme poverty? This study has determined that the program has had a huge impact on agricultural production, which in turn raised real and nominal income for smallholder farmers, both the largest and poorest social group in Malawi. Yet, this paper does not argue that subsidizing grain alone will not solve “world hunger”. Rather than eating maize, poor households seek (and require) complex and diverse calories like the rich in the West\textsuperscript{102}.

What agricultural subsidies can do is help Malawi break into the global food market, like Brazil, and become a sustainable net exporter of food crops. This increase in income can help create a larger tax base, which can both sustain the program and finance other government services that have positive externalities for the community (social safety nets, public health initiatives, etc). While these effects have not been observed yet, one hopes that Malawi’s agricultural boom is accompanied by long-term GDP growth\textsuperscript{103}.

\textsuperscript{101} Peters pp. 176
\textsuperscript{102} Abhijit Banerjee and Ester Duflo, Poor Economics, Public Affairs 2011. pp. 40
\textsuperscript{103} Malawi’s GDP grows enormously after 2005, but so does the GDP of most other African economies. See Appendix for a graph of GDP growth.
Of course, even if all the poorest agriculture-dependent economies improved their yields as Malawi’s did, it is unclear whether they would succeed in today’s globalized economy. David Ricardo wrote long ago about comparative advantage in free trade. Yet, such a utopian idea fails to exist. While the growth of the most developed economies was driven by the growth of the agricultural sector, today’s developing economies cannot enjoy the same luxuries as they did (such as the benefits of colonialism). Malawi’s success came from its following of Europe’s and the United States’ example of agricultural protectionism.

However, developing countries may in fact succeed because of self-interested Western incentives. With the advent of biofuels, maize subsidization in the West has started to play a role in the geopolitical agenda of energy self-sufficiency and environmental advocacy. This increase in demand has effectively shot up global food prices\textsuperscript{104}. While this is currently a negative for the world’s poor, perhaps developing agricultural economies can use this as a way to break into the global market, and use this growth to diversify into other sectors.

Robert Bates states that the incentives for farmers are based on three different markets: the commodities market, the inputs market and the consumer market\textsuperscript{105}. As witnessed in the Malawi case study, government policy can help line up these incentives to promote food security. However, this has to be done

\textsuperscript{104} Kurlatzick pp. 63
\textsuperscript{105} Bates pp. 3
through central planning. Asia’s Green Revolution was supported by state-run subsidies, rural credit and investment in infrastructure\textsuperscript{106}.

Malawi is currently following a sound course. It is investing primarily in maize production, but also promoting some tobacco production to augment wages and diversify crops (without it being too socially and environmentally detrimental). Tobacco production is being kept low in order to keep prices high, while high maize production is keeping domestic prices low. Both increase the poor’s real wages.

The world’s economies have typically followed a certain path. Nearly all economies were built on agriculture. From the age of industrialization, employment shifted towards manufacturing and service industries. The third stage of development, in a market economy, was the emergence of the financial sector. This has been the path most successful economies have taken today (with “minor” hiccups). This pattern is what the IFIs claim to advocate for developing economies. However, I hypothesize that state intervention must fulfill the traditional role of the financial sector in a globalized economy. Since most economies are globalized, they are liable to volatile foreign investment and competing price fluctuations. In order to promote its nation’s own growth, part of the government’s financial role must include a degree of protectionism. Perhaps once an economy is developed enough, it can create its own financial system and will not have to rely on government intervention. By producing wages and

\textsuperscript{106} Denning pp. 1
savings, subsidies can help stabilize the borrowing-lending patterns that have otherwise caused smallholders to default and create socio-political instability, and possibly create a new class of “lenders”.

The IFIs must allow developed nations to play by the same rules as developed countries, and have confidence in government where it is warranted. No government policy is perfect, least of all in the “West”. Malawi’s determination may slowly be changing the attitudes of donors. The UK’s Department for International Development donated $8 million to the subsidy program in 2009\(^{107}\).

For all its shortcomings, the program has staved off severe food insecurity, and food insecurity leads to deepening poverty. In times of crisis, subsistent farmers must sell assets to get what food they cannot produce themselves. Without these assets, economic growth and diversification cannot occur. The subsidy program will not be sustainable forever, and Malawi’s economy must get to a point where it can support itself. Yet, it can be one of the many key investments that must be made to help people out of poverty. Whatever outcome Malawi achieves, good or bad, it will prove invaluable insight into development practices that may be applied to other developing nations.

\(^{107}\) Masina pp. 67
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or False Start?” Institute for Development Policy and Management. University of Manchester, 2005.


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FAO GeoMapping Database. [www.fao.org/geonetwork](http://www.fao.org/geonetwork)
Appendix I: GDP Growth of Malawi and other Sub-Saharan African Nations
Appendix II: Map of Units of Analysis
Appendix III: Map of Cluster Districts in 3-Country Analysis
Appendix IV: Sample Map of Soil Data

Soil Quality Of Malawi and its Neighbouring Districts