NGATI MUKUWERENGA NDICHEDWA KALE KALE
PIECES OF THE PUZZLE: AID, EDUCATION AND GEOGRAPHY IN MALAWI
A COMPARISON OF GIS AND MANUAL METHODS FOR INCREASING OWNERSHIP OPPORTUNITIES IN INTERNATIONAL AID TO EDUCATION IN MALAWI

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ABSTRACT

Olivia Scott Kamkwamba: Ngati Mukuwerenga Ndichedwa Kale Kale, Pieces of the Puzzle: Aid, Education, and Geography in Malawi
(Under the direction of Xue Lan Rong)

School construction remains a crucial tool for international aid organizations (IAOs) that seek to eliminate barriers to economic growth and educational attainment in Malawi and throughout Africa (Moss, 2011; Sperling & Winthrop, 2015). The process of selecting sites for new school construction is a difficult task for IAOs because of their need to select sites using methods that are as "impartial," "equitable," and "data-driven" as possible (Mawdsley, 2017). As such, the selection process can be lengthy, siloed, and feature limited involvement from the Government of Malawi (Collins, 2011). Ultimately, the selection process for new school construction can undermine IAOs efforts at increasing ownership of foreign aid projects by the Government of Malawi (Chirwa, 2012; Bizhan, 2016).

This research uses a mixed-methods case study design to explore how Geographic Information Systems (GIS) can be utilized in the process of selecting sites for construction. Using my experience living and working in Malawi and Mixed Methods GIS, the study compares manual and system generated sites for future construction. Criteria for manual and GIS sites include quantitative data provided by the Malawian Ministry of Education, Science, and Technology (MOEST) analyzed with linear regressions and multilevel modeling. GIS processing was completed using ArcGIS Pro. The GIS-generated results were compared with manually-generated site selections, revealing that the GIS process featured more opportunities for partnership in future site selections.

Keywords:

for colored girls who bump dreamville and dare greatly.

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PREFACE

Ngati mukuwerenga ndichedwa kale kale translates roughly into "If you're reading this it is too late." The above translation is not proper Chichewa; I do not speak proper Chichewa. The Chichewa here is in reference to an album by recording artist Aubrey Graham, also known as Drake, released without prior warning in mid-February 2015. The title represents three salient points that I ask the reader to keep in mind while taking in this writing and how they reflect on my position as a researcher. These three points are reflections on: the limitations of English and written communication, the urgent need for appropriate technologies in research on the African continent, and the shortfalls of institutions. Below, I discuss these points briefly, delineated by album titles. I do not attempt to distill the albums' content, context, or histories into text—the albums are mentioned for those who know them, and for others willing to listen and engage further with them, as I do not do this work for the reader.

K.O.D.

I offer a rough translation of Drake into Chichewa to challenge the notion of what academia believes headlines, titles, and keywords can do for disseminating research. Language does not neutrally reflect reality, and English does not have a universal command on all ways of knowing, understanding, and being (Coetzee, 2019). Instead, keywords, titles, headlines, and even album titles should open a door for conversation on what possibilities exist.

In Dar es Salaam, Tanzania at Mwalimu Nyerere Memorial Academy (MNMA), there is a small library full of the musings and speeches of the teacher/intellectual/first post-colonial president of Tanzania, Julius Nyerere. As I toured the space, my hosts repeatedly apologized for

the low number of materials in English. There was no mention that Nyerere was very intentional about his use of Swahili as the ideal tool for speaking with his intended audience, Tanzanians (Nyerere, 1967). In reply, I apologized for my Swahili, and we began a conversation on the dominance of English in eastern and southern Africa. MNMA can only award degrees in English, and even dissertations for the Language Ph.D. in Swahili must be translated into English before a student can graduate. The fact that a higher institution that prides itself on the dominance of non-English discourse requires its students to submit dissertations in English is one glaring example that reflects the hegemonic nature of Western academic discourse in Africa. Non-English titles and dissertations in Swahili are only barriers to information sharing if we allow them to be. Using google translate, I can hover my phone over a street sign in Japan and translate the Kanji characters instantaneously. My phone screen will show that same sign, now in English, using Latin characters and a font that resembles the real-world sign in color and size. The university, in its insistence on English as the only way, uses language which speaks primarily to those who have been initiated and is often in dialogue only with itself (Coetzee, 2019).

MacCabe and Yanacek (2018) point out the obvious flaw in a system where *key*words seek suitable locks in order to explain a problem or justify an answer—it is a circuitous and vicious cycle of its own. Williams (1976) offers these same thoughts in his exploration that "decolonize" and "collaborate" should not be used to justify a researcher's work as ethical so they can check an IRB box: rather we should seek conflict within the range of possibilities and live within the range of shifting meanings, continuously answering and responding.

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Next, the title is a call for better tools and appropriate technology in IAOs and aid to education. Applying appropriate technology in aid decision-making can break down silos in ways that eliminate imaginary hurdles. For instance, IAO restrictions did not allow R (as a freeware program) to be downloaded onto government computers, private computers were not permitted in IAO offices, and there was no budgetary provision for access to SPSS, SAS, or STATA. With those options removed, the quickest way to process data during my time in Malawi, was to do analysis by hand. My tools were sticky notes, highlighters, reconstructed paper maps, and pens. I made assumptions on whether rivers or mountains were passible and how topography affected distances. I analyzed raw test score data and mapped nearly every existing public primary and secondary school using hand measurements and Excel. Despite the existence of better technology, manual calculations were deemed to be the most effective way to complete the task.

Emerging GIS methodologies present multiple methods for analyzing school data. In the chapters that follow, I explore how spatial analysis with ArcGIS is well-suited for site selection in ways that incorporate multiple factors; its outputs results in dynamic visual displays that can allow for better policy design and decision making (Wiseman, 2010). The potential for GIS is gaining interest in healthcare but has yet to cross over to education and international aid, just as is the case other development sectors (Yoon & Libineski, 2017). The future of international aid will depend strongly on its ability to lean on appropriate technologies and increase the flexibility of its systems in order to fully incorporate in-nation capacity above and beyond simply importing solutions. (I discuss this at length in Chapter 2.) When it comes to technology and aid, solutions exist; we must choose to apply them.

Carter V

Finally, the title is a reminder of the unshakable weight of institutions. I have listened to countless albums as I tried to ignore, digest, and dissect the many new experiences, mixed messages, and contradictions I was privy to in both Lilongwe and Wimbe and how the glimpses of families, schools, communities, and organizations I saw all over Malawi spoke to the work I was doing with IAO. There were many moments when Cole, Kendrick, and Noname served as counselors, and I have no reason to doubt that they will continue to do so. Hip-hop holds a very real (though often sexist, regionalist, and self-deprecating) place in the political lives of young black Americans, and over the past 30 years it has become the world's most popular genre (Brooks-Tatum, 2012). While I may be theoretically correct in my critique of the shortcomings of aid to international education, I found no single organization increasing access to education in Malawi at the rate and scope of IAO. As much as I like to "celebrate February like it's my b-day," and support with sincerity hip-hop artists that the radio could never stomach, I remain subject to the same systems and institutions that make Drake Billboard's hottest artist and international aid my first instinct in addressing educational disparities in Malawi (Lamar, 2015).

My relationship with Drake's music is complicated, but his existence as a commercial titan of present-day hip-hop is undeniable. Drake's presence on the world stage was solidified with the founding of OVO Sound in 2012; short for October's Very Own, the label came to define Toronto's sound with hits by PARTYNEXTDOOR, iLoveMakonnen, Majid Jordan, and the annual OVO Fest. Drake's silent album drop in 2015 was an unambiguous message to the hip-hop community that had hated on his sound and message for almost a decade—"I made it, and there is nothing anybody can do about it" (Williams, 2015; Pope, 2016). In a sense, Drake was telling the world he had achieved the level of "institution" within hip-hop. Yet, Drake's claim to be a self-made icon is at odds with the well-documented support he received from

existing artists and industry giants. When Drake deviates from his well-established lane of rap love hits, it is often to chronicle the struggles of his solo journey to success: “Fake Love”; “God’s Plan”; “Started from the Bottom”; and “Legend” are a few examples. The idea that the artist established himself as a global icon without the support of the industry or anyone around him is, of course, an unfair depiction that holds a metaphor for the dual sides of “institutionalism” relevant to this discussion on aid and education (Lamar, 2015).

When OVO Sound was founded in 2012, Drake was still signed to Lil Wayne’s Young Money Records (2005), itself a subsidiary of Cash Money Records. Cash Money Records (1992), in terms of financials, longevity, and notoriety, is one of hip-hops most successful record labels. However, this record label sits under the hierarchy of Republic Records and Universal Music Group (Dougherty, 2014). While Drake claims that he made it on his own, it is painfully clear that Drake’s status is only possible because of the mentorship and guidance of Lil Wayne (Higgins, 2012). In the same vein, despite a plague of leaked material early in his career, Wayne exists as a global hip-hop icon not because of his incredible mixtape catalog, but largely because his commercial releases reflect stereotypical narratives of black life in America. Unlike “mixtape Wayne” who built a career on lengthy metaphors, intense wordplay, and stolen beats, Wayne’s commercial music featured prominent stereotypes of “money, cars, and hoes” that marketing machines love packaging for sale and distributing globally in order to reinforce the systems and mindsets that keep marginalized people quiet, distracted, and incapable of imagining change (Spence, 2011).

The complicated issue of “institution” in hip hop mirrors those found in the aid industry and its layers of bureaucracy. Some of the young Malawians I met in Lilongwe were as well versed in boot-strap mentality as any statistics major—the system is designed to output

individuals who protect themselves and those who conform, at all costs. What follows this preface is a piece of the puzzle, the other chapters in this work provide more glimpses of what made all this writing possible, but they can never capture the whole. I do not attempt to write the entirety because that task is an impossible one. Writing alone can never be the beginning and end of any meaningful thing; this is one truth I hope the reader takes away from however much time is spent with these words.

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LIST OF ABBREVIATIONS

ACE	American Council on Education
BRICS	Brazil, Russia, India, China, South Africa
DBS	Direct Budget Support
DFID	Department for International Development
EDI	Education Development Index
EFA	Education for All
EGRA	Early Grade Reading Assessment
EMIS	Education Management Information System
FPE	Free Primary Education
GCE	Global Campaign for Education
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GNI	Gross National Income
GOM	Government of Malawi
IAO	International Aid Organization/s
IRB	Institutional Review Board
IMF	International Monetary Fund
ISIS	Islamic State of Iraq and Syria
MASDAP	Malawi Spatial Data Portal
MGD	Millennium Development Goals
MMGIS	Mixed Methods Geographic Information Systems
MMR	Mixed Methods Research

MOEST	Ministry of Education, Science, and Technology
MTM	More Than Me
ODA	Official Development Assistance
OECD	Organization for Economic Coordination and Development
PGBS	Partnership General Budget for Support
PSLCE	Primary School Leaving Certificate Exam
RCT	Randomized Control Trials
SACMEQ	Southern and Eastern African Coalition for Monitoring Education Quality
SDG	Sustainable Development Goals
SEED	Secondary Education Expansion for Development
SWAP	Sector Wide Approach
UN	United Nations
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UPE	Universal Primary Education
USAID	United States Agency for International Development
WIDE	World Inequality Database

CHAPTER 1: INTRODUCTION

Introduction

As an intern for a large international aid organization's (IAO) education offices in Malawi, I worked extensively on the Secondary Education Expansion for Development (SEED) grant. The SEED project seeks to address the shortage of secondary schools through expansion and new school construction, partner with the government to train and hire qualified teachers, and vastly reduce the barrier of cost by eliminating tuition fees at public secondary schools (IAO, 2018).

In 2017, 85,000 students completed the secondary school entrance exam but were unable to advance in their studies because there were not enough schools to accommodate them. In 2018 that number jumped to 130,000 (USAID/Malawi, 2018). The educational infrastructure gap in Africa is, in many ways, a natural result of colonialism, neo-liberalism, and flawed aid practices (McCowan & Unterhalter, 2015). School construction by international aid organizations is not the only solution for addressing the harmful legacies of unequal institutions, but it is one worth consideration. This dissertation uses a mixed-methods case study to reflect on the practices and policies IAO's use to decide where, when, and how to construct new schools and the extent to which the Government of Malawi is involved in these discussions.

Constructing a Malawian school in partnership with an IAO costs an estimated $294,400 per school, which includes construction materials, site evaluation, and school furniture but does not account for construction labor costs, administration, or staffing (Scott Kamkwamba, 2019). To create enough physical classrooms to serve just thirty percent of the eligible secondary school

population would require building 805 schools at an estimated cost of $237 million—nearly two-thirds of the entire Malawian education budget—without any provisions for teachers, staff, maintenance, or repair of dilapidated buildings (Scott Kamkwamba, 2019). The current level of need for new school infrastructure is far higher than the limitations of the Malawian budget can meet. With the Malawian population expected to more than double by 2050, addressing educational infrastructure gaps in Malawi is a clear and persistent need deserving of action-oriented research (United Nations, 2018).

Addressing capacity constraints through school construction has long been a tradition of IAO's in Africa (Samoff, 1999; Bizhan, 2016). The 2016 IAO SEED grant is one example of a multi-million-dollar school construction project in this tradition. SEED is structured in several phases. Initially, IAO constructed sixteen secondary schools and one girl's dormitory in eight of the thirty-two educational administrative districts (Dedza, Nsanje, Mulanje, Thyolo, Chiradzulu, Machinga, Balaka, and Mzimba North). The second phase of SEED will feature the construction of between one and eight secondary schools in each of the thirty-two education administrative districts over five years. At the end of the five years, this construction will yield 150-200 new secondary schools, increasing the overall capacity of Malawian secondary schools by 15-20% nationwide (Scott Kamkwamba, 2018). The Government of Malawi, in accepting SEED funding from IAO, also agreed to eliminate secondary school attendance fees nationwide and immediately hire 10,000 trained teachers (IAO, 2018).

This mixed-methods case study is an in-depth look at Phase II of SEED through both qualitative and quantitative lenses for critical insights about future policy. Initial criteria for selecting sites were discussed in planning meetings between the Ministry of Education, Science, and Technology (MOEST) and IAO staff. To ensure results were "data-driven" and "corruption-

free" it was determined that potential sites would be manually generated, ranked, and finalized at IAO offices and then sent for final commentary to MOEST. Countless human hours at IAO were spent studying districts maps, student test scores, and the distances between existing primary and secondary schools to determine where new secondary schools could provide the most significant impact for the families and communities they would serve. The time-consuming practice of manual calculations left little space for involving MOEST officials throughout the process, and ultimately diminished ownership principles of Malawians in deciding where new schools could and should be constructed. This mixed-methods study is an exploration of how GIS-generated selections would have altered the site selection process and overall communication practices between IAO and MOEST.

Use of GIS technology for site selection is not a non-controversial undertaking, nor is it well-suited for all land-use projects (Harris, Hopkinson, McCaffrey, Huntsinger, 1997). Currently there are no published studies for comparison of manual methods versus GIS systems for selecting optimal sites for school construction. Nevertheless, at IAOs throughout Malawi, the barriers to GIS use are being eliminated as multiple full-time GIS specialists are hired and trained across organizations. Additionally, MOEST and the Ministry of Planning both have full-time GIS specialists and department staff hired to analyze the vast amounts of data collected by IAO projects throughout the nation (MASDAP, 2019). Still, this research is not meant to be an exploration of the technical possibilities of GIS use in education research; rather it is an exploration of how IAO staff might incorporate GIS analysis in developing future school construction projects. Ideally, this case study research contributes to the knowledge of possible use-cases of incorporating new GIS methodologies in determining criteria for selecting optimal sites.

There have been a number of barriers to GIS use in IAOs in the past. One of the most important has been cost, followed by the time commitment to set up and use GIS, as well as technical barriers. GIS software costs have fallen significantly over the past three decades (Mann and Saultz, 2019). This research uses ESRI's ArcGIS Pro software, considered the premier spatial analytical software. High licensing costs present serious financial barriers to small organizations but are potentially bearable by IAO because they allow for the inclusion of EMIS and previous project data that has been collected across decades of projects in Malawi. Open-sourced GIS software, such as QGIS, have similar capabilities to ArcGIS and can be substituted for use with an expected increase in processing time; procedures that can be completed with ease in ArcGIS Pro will take more technical expertise to complete in QGIS.

These cost and technical work-arounds do not mean that technical barriers to entry in GIS have been overcome. In 1997 it took nearly twenty hours to digitize maps, in 2020 this process takes less than five minutes. Still, nationwide site selection requires a lot of data input: e.g., generating a network layer for Malawi using roadways and footpaths required over twenty-four hours of processing time in ArcGIS Pro. Yet once this network layer was created, simulations of site selection could be processed using multiple combinations of criteria in mere minutes for the entire nation or a single district. Even with the technical barriers and time commitments in mind, IAO might benefit from exploring the use of GIS techniques. The recurring nature and significant costs of large-scale construction projects in Africa mean that GIS technology could allow for the ability to incorporate the vast amounts of data previously collected from past projects and studies, the possibility of simulating multiple sets of selection criteria, and the option to permanently store results for future projects (Harris, Hopkinson, McCaffrey, Huntsinger, 1997).

In addition to the technical and price barriers, the historical uses of GIS technology have been a barrier. GIS is a military-originated technology, and its adaptation for use in education and other social sciences has been limited. Decades of GIS expansion into fields such as geography and spatial analysis have led to emergent GIS methodologies such as mixed-methods GIS, qualitative GIS, critical GIS, and non-quantitative GIS. Together these new GIS methodologies seek uses of GIS that are not primarily focused on military or capitalistic outcomes. As the field and terminology are new, this research uses the terms mixed methods, qualitative, critical, and non-quantitative GIS interchangeably, except when the authors cited specify the use of a specific term (Cope & Elwood, 2009).

IAO's will continue to build new schools in Malawi and throughout Africa. Due to the high associated costs, wide-ranging social and economic impacts, and increasing capacity needs of building school buildings, new school construction and methods for selecting school construction sites have real-world implications for future aid and development practices in Africa. There currently exists a deficiency in educational research that explores school construction practices in Africa (Dunn, Atkins, & Townsend, 1997; Filmer 2007; Chumacero, Gomes, Paredes, 2011; Lubienski & Lee, 2017; Gieseking, 2018). Utilizing Geographic Information Systems to assist in future site selections, and analyzing how GOM, MOEST, and IAOs can work together to ensure more significant principles of ownership in school construction projects are timely, pragmatic work that can immediately shape international aid to education.

In the next section, I outline my positionality as reflections of the unique historical and life factors that took me to Malawi and offered IAO as a place where I could grow, conduct research, and become a potential agent of change.

Researcher's Positionality

"Twice as hard" was not something I learned from movies. I was told by teachers, pastors, aunties, and well-meaning strangers. It was whipped into me by my dad, a remarkable parent of eight. It was reinforced by my mother, who works harder than almost anyone I know only for life to continually delegitimize her efforts. It was taught to me by my mother's mother on summer vacations at her home. Taught again and again by my extended family, so southern that my grandfather traced our family tree back to the slave ship that brought us here. So southern, I know precisely which rich white family used to call our family property—that other family has streets named after them in the town we come from and successful real estate ventures. I come from generations of teachers, pastors, and pioneers from small towns in South Carolina—Florence, Effingham, Blenheim, and Bennettsville. Generations of service professionals that were not always able to pass black southern middle-class stability and success to their offspring. The fragility of it all, of the south, of blackness in America, this was all told very plainly to me by people who do not need advanced degrees to see the world for what it is.

I was uncomfortable mapping out where $200 million should be spent in a land where I had barely lived for six months. Of course, SEED was already in motion and would go on with or without my input; my ego insisted the work would be better for my awareness of the previous harms of IAOs in Malawi and throughout Africa; for my acknowledgment of the living legacies of colonialism and slavery and anti-blackness; for my life as a black woman in America, from the south, ivy-league graduate, black theatre producer, pursuing advanced degrees at the University of North Carolina at Chapel Hill. I was, after all, a Gates Millennium scholar with the license and funding to stunt as my ancestors might have—or at least someone with the time, space, security, and privilege to imagine that I could. So, I lived in guesthouses with high fences

and twenty-four-hour security guards and all the excess of American homes, and I battled with myself, questioning if the work mattered and whether I was helping anyone but myself.

Over the course of administering the SEED grant, I came to terms with the fact that I was not always part of the solution. I worked hard, but I was changing nothing. My hard work could be used to perpetuate imbalances in the aid economy of Malawi. My hard work could be used to reinforce existing power hierarchies where "capacity building" and "skills training" are code for assimilate or be replaced—a system where donor nations unabashedly hold negotiating power over recipients. In those years I drove Malawi from north to south and east to west, I picked up some Chichewa, and I saw up-close how passionate people working with IAOs from all over the world were truly changing lives for the better (Banerjee & Duflo, 2011). I also grew in the understanding that aid and development were not designed with an end in sight (Moyo, 2009). I saw first-hand how an empowered class of bureaucrats could bring to life real-world consequences fueled by the myth of scarcity, how they could shape national outcomes in incredibly powerful ways (Englund, 2006). Ultimately, I came to the understanding that IAOs still have an essential role to play in increasing access to education, but the system desperately needs change.

This research is about those years of growth—on looking back at systems, data, and processing, and finding a better way to go about it. I offer my journey and the following questions and analysis, not as the single greatest solution but as the start of what can be possible in school construction by aid organizations in Africa. My analysis with GIS will not provide a list of "must-build" locations; instead, it will serve as a template that can be used in conversation to find an agreed-upon set of conditions and factors for selecting new school construction sites.

Mixed methods is founded on a sense of complementarity, and throughout this research I use both first- and third-person writing in order to combine the strengths of both voices, inspire a critical response from the reader, and attempt to close the distance between myself and whoever reads this works (Zhou & Hall, 2018). In opting to incorporate the intimacy of first-person writing and the supposed objectivity of third-person writing, I offer paradigmatic mixing and political legitimation to this mixed methods study (Onwuegbuzie & Johnson, 2006). It is not my intention to confuse the reader, but I do ask that the individuals approaching this work seek to understand the personal anecdotes and the statistical presentations as equally important to understanding this research; they are intentionally employed to facilitate a greater understanding of the process of selecting sites (Zhou & Hall, 2018). Below, I list the research questions before transitioning into the literature review. As the foundations of this work may be unfamiliar to some readers, key terms and concepts are explained in Appendix A.

Research Question

My research question is meant to serve as a guiding philosophy as I share my experiences and analyze SEED data; this is not an answerable question, but it does provide insight as to how I conceive of my time in Malawi. In Chapter 4, I share more about my methods and research design.

1. How do Geographic Information Systems (GIS)-generated sites compare with manually selected sites for new school construction in terms of expanding opportunities for local ownership in future school construction?
    a. What is the history of international aid to education in southern Africa and Malawi?

b. How can GIS data analysis be employed to assess land for new school construction?
c. Do GIS analytical methods validate or contradict the use of manual methods for selecting school construction sites by International Aid Organizations (IAO's)
d. What are the implications of the above for future school construction projects by international aid organizations in Malawi and throughout Africa?

CHAPTER 2: AID, EDUCATION, & GEOGRPAHY

International Aid & Education

There is no education system in the world that cannot benefit from some improvement. From Blantyre to Bennettsville, educators describe discussions with policymakers, bureaucrats, journalists, and eccentric family members—nearly everyone believes their education systems to be lacking in some respect. Citing hope in this conundrum, Heyneman (1999) believed educational aid to be on the brink of an era where "all countries are borrowers, and all are donors." Twenty years later, we remain on the verge, destined to be perpetually perched, perhaps largely due to the question of Africa. While the world has seen remarkable gains in eradicating global poverty and increasing school enrollments and educational attainment over the past half-century, the gains experienced outside of Africa remain a near-myth to the ultra- and extremely poor in parts of Africa and Central Asia (Collier, 2007).

International educators, Comparative Education studies, aid and development organizations, and international policymakers all agree that the next (and final) frontier in eliminating global poverty starts with education in Africa. While these fields often clash when determining "what works" (Pomerantz, 2004; Sachs, 2005; Easterly, 2006; Moyo, 2009; Banerjee & Duflo, 2011) they all seem to agree that the problem is concentrated in Africa and that money is (at least partly) the solution. How was such a consensus reached?

This section provides a review of literature that explores the role of international aid in improving education in Africa. I write on the foundation that there can be no such thing as apolitical development or apolitical education (Nyere, 1967; Ferguson, 1990). I begin by

clarifying how I use “Africa” and “aid”, and what either of these has to do with the politics of education. From there, I discuss the major players in the international education aid industry by tracing the history of the Education for All movement, along with its effects on education systems in Africa. Next, I outline rationales and objectives for aid by offering a variety of theoretical positions as a frame for what motivates aid. Finally, I describe how advancing ownership principles and the use of GIS could lead to more efficient and effective aid.

The Inconvenient Continent

In “How to Write About Africa” Wainaina (2005) instructs foreigners to forget about the details because “Africa is big: fifty-four countries, 900 million people who are too busy starving and dying and warring and emigrating to read your book.” Wainaina’s satire gives voice to growing frustration in his native Kenya, and throughout the continent, that even as technology, commerce, and media allow for increasingly diverse depictions of Africa, the stereotype of a deprived continent ever in need of a savior persists (Adichie, 2009). The aid economy, and the global political system that sustains it, is partially responsible for perpetuating this stereotype.

Africa is not a monolith. It is beyond the scope of this review to attempt to illustrate the immeasurable beauty of uncountable shades that exist in diverse abundance in Africa—and everywhere humanity thrives. It is not my intention to ignore or reject that diversity. Still, when I use Africa in this paper, I am referring to a specific economic demographic of Africa: the ultra-poor and extremely poor. These populations are, in many ways, an over-studied and over-represented segment of Africa in American universities and research centers (Spence, 2011; Tate, 2004). I refer to the ultra- and extremely poor because I believe the promise of education holds the greatest potential for these populations and because the African ultra- and extremely

poor are often operationalized in the aid conversation as a moral problem, waiting to be solved—instead of a fully capable populace situated in an unjust society and global order.

The ultra-poor are defined as those who consume 80 percent of the minimum dietary requirements while spending at least 80 percent of their earned income on food (Lipton, 1986). The overwhelming majority (78%) of ultra-poor people live in 14 countries in Asia and Africa and are the most vulnerable to seasonal fluctuations and limited availability of goods; this is particularly true in Africa (Marsden, Brown, & Merchen, 2018). The extremely poor are those living on less than $1.90/day; more than half live in Africa (Banerjee & Duflo, 2011). According to most international development literature, while the world forges ahead, the ultra and extremely poor in Africa lag behind; refusing to fit neatly in the globalization storyline, outright rejecting the modernity ethos of standardized "global norms", this Africa is an "inconvenient continent" in more ways than one (Ferguson, 2006). Ultra and extremely poor Africans represent a parallel public and exception to the forces of neoliberal subjection (Spence, 2011). The ultra and extremely poor in Africa are a persisting manifestation of the "problem of the color line" and the main motivation for aid and development in education systems (Du Bois, 1903; Gonzalez, 2014).

The extremely and ultra-poor in Africa are—offensively—referred to as the "bottom billion" by some development specialists. In the oft heralded "Bottom Billion," Collier (2007) traces a linear story of social progress that questions how six billion people on the planet seem to live markedly "better" lives than the one billion extremely and ultra-poor people. Collier (2007) reasons that poverty is not "intrinsically a trap; if it were, we would all still be poor." The book's title reinforces a hierarchical positioning that is typical of aid and development; in an attempt to motivate economists and global lenders, a moral appeal is made for "assistance" to these

"bottom" billion rather than justice for all of humanity's sake. It also posits that nothing of value exists in the lives of the poor except the hope that they can "develop" into Western nations (Williams, 1976; Baraka, 1995; Escobar, 2012).

Still, Collier (2007) makes compelling and actionable claims in his discussion on how conflicts, natural resources, bad neighbors, and poor governance have allowed globalization to marginalize one-seventh of the world's population—and what can be done by the rest of the world to raise the standard of living for the planet's poorest people. Aid and education are two of Collier's top solutions.

More Money, More Problems

There are three categories of international aid: humanitarian/emergency, charity-based, and systematic (Moyo, 2009). Humanitarian/emergency aid is given primarily in response to disasters, both natural and human-made, such as floods, famine, fires, and wars. While Africa does receive this type of aid, it is hardly ever distributed to systems of education, and this paper does not discuss it. The remaining two types of aid, charity and systematic, are most concerned with education systems in Africa and correspond respectively to what Collier (2007) calls the *buzz* and the *biz* of aid. The buzz is the "headless heart" that gets attention and moves quickly, while the biz is the slow-moving ship comprised of governments and supporting organizations.

The Buzz of Aid. Charity-based aid is mostly the work of international religious organizations, social media campaigns, corporations, and celebrities. This type of aid is typically short-term and near-sighted; it thrives off of large numbers of relatively small gifts and catchy phrases or slogans. Examples include Bono's Product (RED) line, village "adoption" programs, and religiously affiliated entities. Charity-based aid has immense and immediate impact on education in Africa; a single gift of a school or scholarships can fundamentally change the lives

and trajectories of an individual student or community, but charity aid is not without its criticisms.

In October 2018, ProPublica and Time Magazine published a lengthy profile on the More Than Me (MTM) Academy in Liberia that featured many of the hallmarks, and pitfalls, of charity-based education development in Africa. Katie Meyler, a young, American missionary determined to make the African poor her cause, founded MTM. From the start, Meyler raised money for MTM through whatever means she could, this included selling her eggs, giving celebrities tours of Liberian slums, making videos on Facebook that would earn her one million dollars from the JPMorgan Chase American Giving Awards, and more than ten million dollars from other donors. The first female president in Africa, Ellen Johnson Sirleaf, would join Katie and MTM in opening the inaugural academy. Sirleaf praised Meyler for the skill and dedication she was bringing to Liberia. MTM and charity-based aid overwhelmingly rely on the principle that money and foreign expertise is all it takes to make Africa great:

> Many other institutions [in Liberia]—government, community, family—had failed. But the justification for the presence of outsiders is that, with greater expertise, resources and exposure, they can do better (Young, 2018)

Investigative reporting by Young (2018) revealed that MTM would turn a blind eye while a lead staff member took advantage of students for years, deny having early knowledge of the incidents, and systematically undermine government investigations into the matter. MTM is not an anomaly in the realm of charity-based aid. Interviews with Liberians who were familiar with MTM illustrate the potential ills of charity-based aid: “They think we are all stupid people with little or no education, and our system is fragile, and they can get away with things because their skin is white” (Young, 2018). Today, the organization runs multiple schools for the government

of Liberia, and it is poised to operate more than 500 public schools over the next five years through Liberian government subcontracts, similar to charter schools in the United States.

The Biz of Aid. Unlike the buzz of charity-based aid, the biz of aid is an intricate economy focused on the daily work of improving livelihoods for the poor. The business of aid refers to the governments and supporting organizations that transfer money for poverty relief, including IAOs. Across the past forty years, more than one trillion dollars (in today's money) of Official Development Assistance (ODA) has flowed into Africa, and yet per-capita growth for the same period remains near zero (Moyo, 2009). ODA is the "combination of money, advice, and conditions provided by rich nations and international financial institutions which is designed to achieve economic development to poor nations" (Easterly, 2007, p. 1). Biz aid is given government-to-government in a range of sectors including education, health care, infrastructure, security and peacekeeping, energy, finance, agriculture, and a variety of others. The business of aid is supported by multilateral and international non-governmental organizations, which include the United Nations, British Department for International Development (DFID), World Bank, and International Monetary Fund (IMF). The biz of aid has far less public accountability and visibility than charity-based aid does (Woods, 2005). This side of the aid economy operates budgets that are exponentially larger than most charity-based organizations and with less transparency. Due to direct partnerships with African governments and the sheer size of aid budgets, the biz of aid has the potential for a proportionally larger impact in African education systems than buzz organizations.

One example of how the biz of aid shapes education in Africa is the Tusome reading program in Kenya. Tusome, Swahili for "Let's Read", is a partnership between the United States Agency for International Development (USAID) and the Government of Kenya that promotes

reading in every public and low-cost private primary school in Kenya. To ensure every pupil has access to their own book, USAID (2017) designed and printed 24 million textbooks in English and Kiswahili and produced additional materials for visually and hearing-impaired students. Tusome has trained every lower-grade public primary school teacher at nearly 24,000 schools across Kenya on how to deliver effective and impactful reading instruction in English and mother-tongue languages. Additionally, Head Teachers, principals, administrators, and curriculum support officers were trained in how to support early grade teachers and school-wide literacy in Kenya and at American graduate programs. Tusome has successfully scaled nationwide and uses real-time learner data and Educational Management Information Systems (EMIS) for constant monitoring and evaluation by teachers, parents, and donors (USAID, 2017).

For $74 million dollars over five years, reading culture in Kenya has been transformed at the national and communal levels. Nearly 70% of pupils demonstrate reading fluency and comprehension of grade-level texts; these rates are ten times what other southeastern African nations exhibit on the same Early Grade Reading (EGRA) tests (USAID, 2016).

USAID and other members of the biz of aid community provide textbooks, supplementary readings, trainings, and technology to extremely and ultra-poor students in amounts beyond the budgetary limitations of African government spending on education. When government-to-government aid is well funded and planned in conjunction with local nations, it works to complement and amplify local initiatives for impact beyond what recipient nations can support.

Aid and Education. Emphasis on education by both charity-based and systematic aid organizations is not accidental. Education's power to uplift notwithstanding, it has also been weaponized throughout history as a powerful political tool for state formation:

> Education was necessary as a 'guarantee of order and social stability...to instruct the people is to condition them to understand and appreciate the beneficence of the government'. Clearly, there [is] an explicit link in the minds of state officials between education, nation-building, national identity, and economic expansion. (Robbins & Dowty, 2008, p. 113)

Robbins and Dowty (2008) speak above on the early formation of France and England as political states; how does a sixteenth-century aspiring government unite people of all classes and cultures across linguistic, geographic, and ethnic backgrounds for the imagined unity of nationalism? Education. Education is one of the most powerful and effective tools humankind has for accomplishing any task, including the promotion and destruction of communities (Durkheim, 1922).

Global North/South Divide. The understanding that education historically has and continues to be leveraged as a tool for sustaining community and economic order is a vital component to how I understand aid in Africa and the broader global world order. In this paper, the ultra- and extremely poor in Africa are considered part of the "global south":

> The Global South is not an existing entity to be described by different disciplines, but an entity that has been *invented* in the struggle and conflicts between imperial global domination and the emancipatory and decolonial forces that do not acquiesce with global design...the global south is the location of underdevelopment of emerging nations that *needs* the 'support of the global north'" [emphasis added] (Levander & Mignolo, 2011, p.3)

Previously described as the dichotomy of "the west" versus "the rest," the first/third worlds, or developed/developing nations, it is almost certain that the present day "global south" term will be replaced by something deemed more apt. The global north is considered to be comprised of the nations and international organizations that give to education in Africa and the global south. While I recognize the complexity and missteps in using these limited terms, they remain useful for our discussion of aid on the continent.

Defining the role of international organizations from the global north/south perspective relies heavily on an understanding of soft power that recognizes how the global north agenda dominates international aid organizations. Soft power is defined as the non-coercive use of influence and money to control governments, civil organizations, and individuals that is ultimately responsible for American and Western hegemony in the global order (Nye, 1990). Soft power is used to reinforce the global north/south dichotomy through both aid and education in Africa.

Where historically, intranational aid was required to maintain the legitimacy of the state from within, international aid to education serves a similar purpose in maintaining the global order (Englund, 2006). Aid and education are two of the most powerful tools for improving the living standards for Africa's ultra- and extremely poor populations, but these same tools reinforce systems that ensure the center of power remains mostly unchanged. In the next sections, I discuss who the main actors in aid are, how they have shaped African education, and what motivates their giving.

Who Gives?

> "Far from there being an education universally valid for the whole human race...each type of people has its own education...This is why in one place it habituates the individual to surrender completely his personality into the hands of the State, while elsewhere, it seeks to make of him an autonomous being, legislator of his own personal conduct...This is not because, by a series of aberrations, men have forgotten their nature as men and their needs, but because their needs changed, and they changed because social conditions on which human needs depend have not remained the same (Durkheim as cited in Kandel, 1956, p. 3).

Durkheim is quoted a length because he directly addresses the inherent paradox in global education and international aid to education in Africa. A global system of education must serve

some central needs, and the inherent power dynamic in aid of the donor/recipient dichotomy tips the balance heavily in favor of global north nations.

One of Africa's largest and most notorious terrorist groups is based in northern Nigeria, aligned with ISIS, and known for kidnapping large groups of school girls. The group, Boko Haram, translates to "western education is sinful" (Peters, 2014). In international aid to education in Africa, the major partners are those countries that represent the global north, and their aid to education is received along with the cultural and economic values that accompany it. International aid to Africa guides questions about who education systems should serve and what they should teach. In both direct and indirect ways, educational aid answers questions on whether students should learn competition versus collaboration in the classroom; details of past regional and ethnic conflicts versus polished versions of historical events; or set aims for individual economic prosperity or envision an equally distributed society (Altback, Arnove, & Kelly, 1982). The global organizations answering these questions are primarily based in the global north and affiliated with or funded by global north governments (Eze, 1997).

In the aftermath of World War II, there was a rise in multilateralism through the formation of what are known as the Bretton Woods organizations; this period includes the founding of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the Organization for Economic Cooperation and Development (OECD), and a host of non-state organizations and foundations (Rockefeller Foundation, International Teachers Associations, etc.). While international involvement in Africa dates back to colonial and pre-colonial eras, this section will focus on the main actors in international education in Africa as it relates to the post-World War II through the Cold War era. It is not by incident that global political conflicts are what shapes education systems for the ultra- and extremely poor. Aid organizations, the

individual governments that fund them, and the supporting international non-governmental organizations that work with them are all based in the global north and responsible for the majority of aid to education in Africa.

History of Education for All in Africa

The Millennium Development Goals, and now Sustainable Development Goals are the most recent chapters of the 80-year-old Education for All (EFA) movement. Today, public primary education in Africa, and globally, is technically tuition-free thanks to EFA and the Free Primary Education (FPE) movements. Yet, throughout Africa "free education" often means parents are supplementing school budgets with hidden, mandatory fees charged at the school level which are required to keep children enrolled in schools (Rose, 2003). To understand who are the players that control aid to education in Africa and why they are all generally situated in the global north, I trace the history of FPE and EFA movements. These post-World War II organizations situate the global north as the authority on what constitutes a quality education and who has access to it.

EFA Early Years. Education has been a part of the United Nations (UN) charter since its inception in 1945 called for global "educational advancement," likewise UNESCO was also founded in 1945 with the explicit purpose to advance "education for all." The call for universal access to education was solidified in 1948 when Article 26 of the Universal Declaration for Human Rights declared that education would be compulsory for all children and free at the primary level (Easterly, 2002).

The first 50 years of the EFA movement, roughly 1940-1990, primarily featured discourse without action due to complications within and outside of EFA organizations. Despite holding a dominant presence at the UN and UNESCO, the United States did not ratify the

Universal Declaration of Human Rights until 1992 and still has not ratified the UN Convention on the Rights of the Child, which includes rights to educational access for refugees and children with disabilities (Easterly, 2006). Additionally, membership in the UN and other international organizations grew rapidly as the number of recognized states grew. The change in the number of UN member states was initially due to the end of colonial rule in Africa, Asia, and Latin America, but another set of members came with third and fourth wave democracies in the late 1980's (Englund, 2006).

The expanding number of member states in international organizations complicated planning and coordination for the EFA movement. At the same time, the world's population grew from under three billion in 1950 to over five billion in the early 1990's presenting genuine implementation challenges at the country level (Riddell, 2012). Despite these setbacks, Education for All was renamed as a global priority starting in 1990 when funding and coordination between public, private, and bilateral and multilateral organizations were solidified.

EFA after 1990. In March 1990, the World Conference on Education for All took place in Jomtien, Thailand. The conference featured representatives from UNESCO, UNICEF, the World Bank, UNDP, and several private foundations. With a priority to make education a prominent feature of international development work, the Jomtien conference established the EFA Assessment and called on civil society to fund global education access. Jomtien provided an assessment tool that international organizations would use, along with the promise of donor funds, to shame and motivate governments in Africa to adopt a policy or change national practices. For example, this period saw the implementation of universal free primary school (UPE) in Malawi, Kenya, Uganda, and other African states.

Ten years later in 2000, the global north and key stakeholders convened again to reevaluate the EFA movement in Dakar, Senegal, at the World Education Forum. This forum produced six overall goals for progressing global education:

1. Expand early childhood care.
2. Provide free and compulsory education for all.
3. Promote learning and life skills for young people and adults.
4. Increase adult literacy by 50%.
5. Achieve gender parity by 2005 and equity by 2015.
6. Improve the quality of education.

The Dakar Forum also established the Education for All Development Index (EDI), which evaluated progress on each of the goals through indicators at the country and regional level. Progress for the goals and indicators is published annually by UNESCO in the EFA Global Monitoring Report. The Jomtien and Dakar conferences were crucial in expanding access to education in Africa. Global north development organizations dominated these conferences; government officials from global north nations directly prescribed policy solutions and worked in tandem with sizeable international charity organizations but the voices of African countries and their students were noticeably absent (Kendall, 2005).

EFA Assessments. Since EFA began collecting data using the Dakar framework, the world has been able to trace progress towards the goals established in 2000. The validity of these results is complicated by the difficulty in implementing normative global north monitoring and assessment strategies in Africa; still, they provide some insight into what has been accomplished (Arnove, 2012; Serpell & Simatende, 2016). Below, I briefly describe the six goals and progress towards achievement.

- Goal 1: Expand early childhood care and education— 184 million children globally receive some type of early care, child mortality is down 39%, and pre-primary attendance is compulsory in 40 countries (UNESCO, 2010). 45% of UN (2010) member states are far from achieving all indicators for early childhood care.
- Goal 2: Free and compulsory access to primary school—Universal primary education has seen 48 million more children enrolled in primary education, but delays in funding have stalled progress in reaching the most vulnerable populations (UNESCO, 2010). While global north donors are eager to fund textbooks, school classrooms, and learner assessment materials, they are reluctant to fund more fungible costs such as teacher housing, professional development programs, or administrative salaries, citing fears of corruption.
- Goal 3: Improve secondary and adult learning programs—Secondary schools and lower secondary schools across Africa have seen significant gains in attendance since 2000 but hidden fees, opportunity costs, and limited capacity mean the majority of students in Africa will not complete the entire secondary cycle (Rose, 2005).
- Goal 4: Increase adult literacy by 50 percent—Adult literacy and education have seen higher numbers of growth as populations that were young when EFA was enacted in 1990 are now aging out of secondary schools. Still, Goal 4 has received little funding or attention at a global level (UNESCO, 2010).
- Goal 5: Achieve gender parity and equity at the primary level—the number of girls completing primary and secondary schools has increased (UNESCO, 2010). As a parallel to the feminist movement in the global north, donor organizations sponsor

girl's education in Africa through direct scholarships or building gender-specific schools (Moulton, 2002).

- Goal 6: Improve the quality of education—ensuring quality education remains the most substantial challenge to fulfilling the EFA agenda. The EFA goals and strategies for improving quality have seen significant progress since inception, but still face challenges of implementation, measurement, and funding.

While the EFA era saw great progress and access to education in Africa, it was never fully funding by the global north, and its success was stunted. Part of the EFA funding crisis has been alleviated by the introduction of the MDG and SDGs as global progress frameworks, which further motivated funds from global north governments, corporations, and private organizations.

MDG/SDGs. Alongside the EFA Dakar 2000 conference, a much larger conversation about international development was taking place with the launch of the Millennium Development Goals (MDG). In 2015, the 189 UN member states met in New York City for the Millennium Summit where they pledged to achieve eight goals for global improvement by 2015:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/Aids, malaria, and other diseases
7. Ensure environmental sustainability
8. Global partnership for development.

The eight MDG's were time-bound, qualified objectives meant to address worldwide inequalities. Annually, United Nations member states produced progress reports towards each of the goals as they relate to sets of specific indicators. Where the EFA agenda was broad and

included provisions for all ages and segments of the population, the MDG's only aimed to achieve universal primary school enrollment and the elimination of gender disparity in education—a far more realistic agenda to address. After 2010, global north organizations chose mostly to utilize MDG's as agenda-setting criteria for aid to education in Africa; as such, the comprehensive EFA framework was sidelined, and the focus for education in Africa was largely shifted to funding for primary schools (McCowan & Unterhalter, 2015).

Jomtien, Dakar, and the MDG's led to the growth of the EFA/FPE movement around the world in immeasurable ways. International nonprofits from the global north grew in size and number to implement donor-funded projects and provide expertise on best practices in education in Africa. This has rightly lead Africans from across the continent to critique the idea that solutions to creating quality and progress were being imposed by visiting "specialist" who knew nothing of country-level context (Chirwa, 2012). Additionally, MDG's and EFA saw a rise in the importance and relevance of statistics and data-driven approaches in how grants were awarded and projects were funded, a further critique from the continent (Chirwa, 2012). Several reporting mechanisms and indicators of global progress were developed for the explicit purpose of rewarding and shaming African nations including the World Inequality Database (WIDE); World Bank EdStats; UNESCO Institute for Statistics Data Centre; MDG Indicators Global Database; UNESCO eAtlas for Education; and the World Bank SABER rating. The world of monitoring international aid in African education became an industry in itself and is largely dominated by private organizations headquartered in the global north (Nielson, 2006).

In 2015, the MDG's expired and the United Nations established the Sustainable Development Goals in 2015 to continue progress towards global equity:

Figure 1. Sustainable Development Goals
United Nations, 2016 (Retrieved from: https://www.ghd.com/en-us/about-us/sustainability.aspx)

SDG Goal 4 targets education and aims to ensure "inclusive and equitable quality education while promoting lifelong learning opportunities for all" (United Nations, 2016, Figure 1). The EFA movement also released a new set of global goals in 2015 at the World Education Forum in South Korea. The Education 2030: Incheon Declaration and Framework for Action pushes beyond free primary education and asserts that all nations must provide nine years of free compulsory schooling at both the primary and secondary levels. The Incheon Declaration (World Education Forum, 2015) also advocates for increased provision of early childhood centers, technical colleges, and tertiary institutions. Special directives are made for developing education in conflict areas, for nomadic communities, and for preventing dropouts and child labor (World Education Forum, 2015). The SDGs and new Incheon Declarations call for fulfillment of funding levels for all donor nations as crucial to the success of the Education for All movement.

The SDGs and Incheon Declaration will create immense ripples of change in African systems of education. Free secondary school in Africa will require new levels of funding, more

teachers and administrators, more aid coordination, and more monitoring and evaluation—this will all need to be done in addition to the work remaining at the primary level.

The work of the MDG/SDG are not without consequence. As the Education for All movement grew, it became increasingly apparent that education, and the wealth it brings, are located in spaces outside of Africa (Arnove, 2012). The "brain drain" of intellectual wealth from Africa to tertiary institutions in the global north is one lasting and well-known effect (Tebeje, 2005). While the numbers are purposely convoluted, an estimated 30 percent of development dollars never leave the donor country, and at least 35 percent is paid to foreign "experts" because of "lack of capacity" in Africa (Samoff, 2007). Additionally, curriculum and subject materials that were mandated by EFA are printed in the global north and center the language, teacher trainings, and examination norms of the global north, at times without any adjustment for African contexts (Gakusi, 2010).

Other Actors. The aims and goals of the SDG's and Incheon Declaration were designed primarily by global north organizations and governments and are dominated by the values and norms of these nations; acknowledging the missing voices in international aid administration does not invalidate the work of the individuals and organizations that support international aid to education in Africa. While it is beyond the scope of this paper to trace the histories of smaller and emerging players in international aid to Africa, it is important to mention the role Brazil, Russia, India, China, and South Africa (BRICS) and other fast-growing economies are playing in re/shaping today's aid economy (Pomerantz, 2004). Wealthy philanthropists and their foundations, such as the Gates Foundation, Bezos' Day 1 Academies, and PLAN international, are also influencing the objectives and pace of major actors in African education. Additionally, the African Union and regional coalitions, such as the Southern and Eastern African Coalition

for Monitoring Education Quality (SACMEQ), have the potential to play influential roles in usurping the global north as the de facto authority on African education. In the next section, I offer five theoretical lenses for understanding the rationales behind aid to education in Africa.

How Much a Dollar Costs?

On a single day in 2005, the world managed to deliver nine million copies of a 600-page book, the sixth installation of the Harry Potter series, to people in the United States and the United Kingdom without a "Harry Potter for All" or "United Nations of Hogwarts" campaign (Easterly, 2006). Easterly (2006) cites the inability of wealthy nations to coordinate aid for African countries with the same success as they coordinate commercial enterprises as one of humanities truest tragedies. Ten years after Easterly's observations and the gap is still growing. In the United States, I can order from a selection of millions of items on Amazon and have them delivered in just under two hours for the same price I would pay to have ten sheets of paper delivered once to one of seven DHL hubs in Lilongwe or Blantyre. The inability of international aid systems to effectively deliver sanitary healthcare, sufficient classrooms, or clean drinking water to the extremely and ultra-poor in Africa are sincere motivations for the many people whose lives are dedicated to the development of education systems.

Table 1

Rationales for Aid to Education

Rationales and Objectives for International Aid to Education in Africa				
Theory	**Vision**	**Strategy**	**Link to Education**	**Alternate Titles**
Marxist	Freedom from economic exploitation for peoples and countries subjected to international and local elites	De-linking from dependent relations with former colonial or neo-colonial powers.	Education systems are dependent on former colonial powers and reproduce unequal relations.	Dependency theory; World Systems theory; Social Reproduction
Postcolonial	Critique of representation as 'other' and assertion of authentic voice	Critique and deconstruction of dominant conceptions of development	Education instrumental for disparagement of indigenous cultures and for articulation of critical vision	Post-structuralism; Post Development
Rights-based	Equality of opportunity and fundamental entitlements, of individual agency, wellbeing and liberty	Constitutional guarantees, global obligations and individuals holding state to account.	Educational opportunities must be distributed fairly and must equip individuals for full participation in society	Basic needs; Human Rights; Human Development/ Capabilities; Liberal Egalitarian
Freirean Pedagogy	Transformation of consciousness for the emancipation of the people and creation of a just society	Individual and collective empowerment through learning and action	Education is intrinsic to development; social transformation starts with learning; dialectic of reflection and action	Radical Humanist; Participatory Learning and Action
Human Capital	Economic growth to 'catch-up' with developed countries	Modernizing economic activity and institutions, changing attitudes and enhancing workers' skills and productivity	Schooling instrumental in forming productive workers	Modernization theory; Liberal capitalist; Neo-liberalism

Note. Adapted from "Education and International Development: An Introduction" by T. McCowan & E. Unterhalter, 2015

Table 1 reviews five dominant theoretical positions for the rationales behind why nations and individuals give aid to Africa. I explore the historical origins, current examples, and critiques of three of the five theories in depth because of the frequency with which international aid organizations in Africa apply them; rights-based education, Freirean pedagogy, and human capital theory. The reviews and chart above are not sufficient for exploring the depth of these rationales but they do provide some insight into the objectives of aid as well as the intended effects. The theories are not entirely exclusive and at times, objectives, rationales, and strategies can span several origins of motivation.

Rights-Based Aid

Rights-based aid to education in Africa is centered on principles similar to Nussbaum and Sen's (1993) list of capabilities. Rights-based education assumes that political order and human dignity can only be achieved if and when every individual can express their innate abilities. Popular expressions of rights-based aid can be found in the UN Convention on the Rights of the Child and the notion that nations can hold each other financially accountable for how and when they provide access to education for their citizens (Tikly, 2015).

When South Africa's housing crisis peaked, news cameras captured a homeless man who lamented the nation's notoriously idealistic post-apartheid constitution —he did not want the "right" to housing, he wanted a house (Moyo, 2009). Under rights-based motivations, education is seen as a cure-all social vaccine that can improve agricultural productivity, offer better employment prospects, and reduce infant and maternal mortality, when schooling does not deliver on this promise, the institution of education is seen as incompetent, not the loftiness of the expectations (Kadzamira and Rose, 2003).

The United Nations (2015) assesses nations in Africa, and globally, on the four A's of education: Available, education is free with adequate infrastructure and trained teachers; Accessible, the system is non-discriminatory and accessible; Acceptable, content is non-discriminatory, and teachers are safe and professional; Adaptable, education evolves with the changing needs of society.

Rights-based education is often based on moral motivations and is used by charity-based aid organizations and serves as the legal basis for educational access expansion policies in Kenya and South Africa . Critiques of the approach discuss how, with the rights-based approach, education becomes a vehicle for sanitation and health, democracy, and family planning (Ruck, Peterson-Badali, & Freeman, 2015). Other critiques of rights-based education are that it can be defined in a top-down manner and can be construed in a manner that ignores grassroots efforts (Tikly, 2015).

Freirean Pedagogy

Freirean pedagogy seeks to bring emancipatory education for social transformation by combating the ways of the global north. According to Freirean pedagogy, aid organizations in African education have "ended up using the educational methods employed by the oppressor...they deny pedagogical action in the liberation process, they use propaganda to convince" (Freire, 1970, p. 68).

In Africa, Freirean ideas similar to Freire's approach were popularized by the first president of a newly independent Tanzania, Julius Nyerere. In the quote popularly attributed to Nyerere, he asserts that "you cannot develop people, you must allow people to develop themselves" by using education as a way not to "escape poverty" but to "fight" it. The Tanzanian economy and educational systems show distinct legacies from their East African neighbors,

including the use of Swahili as a national language (instead of English or French) and intentional design of a curriculum that centered anti-colonial activism (Mosha, 1990). While some small charity-based aid organizations operate under a Freirean pedagogy, it is not a motivating principle for the biz of aid. Critiques of the Freirean or Self Reliance approach are that implementation costs are high, it ignores the reality of global capitalism, and that it is generally impractical and overly optimistic (Tikly, 2015).

Human Capital Theory

Collier (2007) describes human capital theory as "one of the ugliest phrases in economics" used to capture the idea that people's skills are valuable and quantifiable. The donor community, led by Hanushek and other economists, see education as a means for economic outcomes that will allow developing nations to "catch-up" to their western counterparts (Sumra & Katabaro, 2014). Human capitalists or Modernization theory views education as a linear input-process-output model where students, teachers, money, and supplies enter the "black box" of the classroom and output productive workers and, eventually, a thriving economy (Sumra & Katabaro, 2014). Best practice inside the black box is contested worldwide, but, in the economic view of education, standardized exams measure quality and prove the "worthiness" of any given educational investment to the donor community (Dembélé & Oviawe, 2007).

In the human capital approach, the global north community supports school choice, decentralization, accountability through public shaming, and external benchmarking as useful tools for raising education quality (Tikly, 2010). The donor community at large has accepted the economic aims of human capital theory as a natural import from western nations where the "standards movement" and race for efficiency dominate education debates and ignore the same

issues of unequal access, weak links to labor markets, and overall poor economic environment they fail to address on a smaller-scales domestically (Gakusi, 2010; Murimba, 2006).

Critiques of human capital theory are based in challenging the assumption that financial capital is the proper measure for understanding and motivating education attainment and point out that educational attainment and lifetime earnings are linked for historical reasons, but are not necessarily causal (Aslam & Rawal, 2016). Additionally, the empirical evidence and economic reasoning that supports human capital theory include errors in defining the equivalence of a single year of schooling between nations; does not account for the global inequality of one year of studying in different nations; and does not address the underlying notion that test scores are an inefficient method for establishing levels of school quality (Aslam & Rawal, 2016).

While human capital theory is the dominant motivation of global north organizations in Africa, there are growing criticisms that it is merely a blind copy and paste of policy from other nations; gross domestic product is not an accurate indicator of social growth; and education cannot alone address the needs of African economies (Tikly, 2010). Human capital theory helps make the current global order and the perpetual cycle of aid to African systems of education, a given—to change the livelihoods of Africa's poor, it will be necessary for the current global north to abandon human capital theory as its leading rationale.

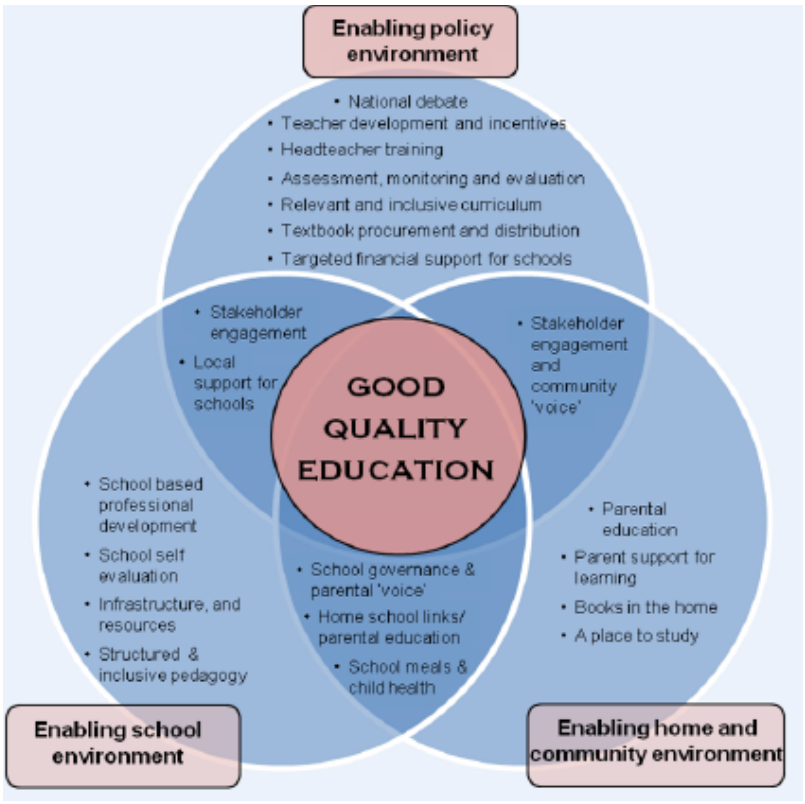


Figure 2. Social Justice Framework for Understanding Quality Education in Africa. Adapted from "Towards a framework for researching the quality of education in low-income countries" by L. Tikly, 2010.

Emerging Theory

"Towards a Framework for Understanding the Quality of Education" provides the beginnings of a new theoretical approach to aid to education in Africa and an outline for how international organizations can work to provide quality education to Africa's extremely and ultra-poor peoples (Tikly, 2010). In Figure 2, Tikly recommends a social justice approach to aid in Africa that emphasizes African capabilities, local values, and relevant curriculums—this approach does not require equal access to inputs or controversially, Education for All. Instead, the model relies on context-specific inputs and processes, motivated and empowered teachers, learning materials fit for the physical environment, large grants for infrastructure, appropriate

technologies, and improved health and nutrition (Tikly, 2010). Implementing this model will require a total disruption of the existing aid economy.

Global north influence on international policy is not inherently wrong, but when it is applied without additional considerations of context, appropriateness, or feasibility, it can work to recreate unequal administration of education across Africa. As aid workers from all backgrounds seek to develop education in Africa, they must address the implications and un/intended consequences behind the *why* of the work.

Donorship

Thus far, I have reviewed the history of how aid is given and who gives aid to education in Africa at large. I have also discussed historical and current challenges to aid and existing critiques. Next, I will explore how the Paris, Busan, and Accra conventions all agree that aid can be improved through increasing ownership of recipients.

The Paris Declaration is a five-principle declaration of what aid organizations can do to make development more successful—ownership, transparency, alignment, harmonization, and focusing on results (Ridell, 2015; OECD, 2011). Of these, advancing ownership principles is the most crucial key for IAOs in education to understand. In this section, I discuss the relationship between global north and south nations in giving aid and what ownership in aid means for quality in African schools.

On November 27, 2017, Malawi President Peter Mutharika published an op-ed, "The Moral Imperative of Quality Education," which reads as a thank you letter to funders (Mutharika, 2017). Mutharika discusses his time organizing and convening conferences, belabors a crisis quality that has "reached [his] doorstep," praises his nation's education spending as an example to the "developing world," and thanks Rihanna for the "spotlight" her trip to Malawi offered.

Mutharika does not mention ownership once. He does not mention that education achievement and attainment in Malawi has stagnated and is in the bottom 10% by most international indicators (World Bank, 2018); that educational quality in Malawi has suffered for a century because of colonial legacies on provision and purpose (Tikly, 2011); that the extremely high 23% national budgetary expense on education—with 60% towards primary schooling—is the result of a donor-enforced conditionality (Collins, 2011); or that Rihanna is hardly a household name in Malawi.

The confusion, and at times rejection, of ownership in education aid are evident in Mutharika's op-ed. The Malawian government does not speak of objectives for an education system that eliminates discrimination or elitism, fosters local entrepreneurship, outlines ideals of citizenship and conflict resolution, or details the history of Malawi from a radical pedagogy point of view. Instead, it reports—and evaluates itself— on the easily quantifiable outcomes of classrooms constructed, textbooks printed, and students attended that donors conveniently use to justify aid (Samoff, 1999). In the next sections, I will outline the potential ownership and quality in aid to education holds for Malawi and other southeastern African nations.

Education and Ownership

Sociologist and educators have for decades known that education is an intimate activity yet in the global education arena, this intimacy is tossed aside for the ends, terms, and conditions outlined by human capital theory, often to the detriment of desired progress in educational attainment and quality (Aslam & Rawal, 2015).

Without local ownership, education can become a mindless and empty exercise. Evidence of this is abundant in official communication to and from Malawi's education sector. Documents produced by development partners operating in the nation offer long preambles on what

education can do economically, why it is needed, and where it should be done—time and again, donors take on the unassigned and unnecessary role of informing Malawian education officials as to what they should be doing and why education matters. In effect, asserting donor power and ignoring the necessity of local ownership in education (Collins, 2011). If global education convenings in Paris, Accra, Dakar, and Busan are correct and aid effectiveness in every sector is to be improved through ownership, then the aid community must be increasingly sensitive to how the education sector responds to these declarations (Collins, 2011).

Defining Ownership

Ownership is at the heart of aid effectiveness, but lack of a clear definition has led to claims of achievements that barely scratch the surface of what ownership can and should look like. At its heart, ownership in education refers to principles outlined in *Pedagogy of the Oppressed;* emancipatory education for social transformation based on the understanding that every individual has within them the tools for their success (Freire, 1970). A liberation understanding of education does not lend easily to a "copy + paste" of "what works" in western nations directly into development contexts; for this reason, ownership in education has been redefined and altered by development partners to fit a vision that does.

Booth (2012) compares ownership in education—and the processes that brought it to the forefront in development—to that of an over-dressed Christmas tree. While the Paris Process, and subsequently Accra and Busan, were grounded in evidence-based insight from decades of aid experience, donors added too many commitments and focal areas on top of ownership (alignment, capacity development, etc.) to satisfy their own needs and desires (Booth, 2012). Instead of facing the daunting task of working with recipient nations to promote ownership—and

ownership alone—as the true key to progress—donors piled on additional areas of consideration that allowed them to debate internally (delivering results) and with other donors (harmonization).

Still, ownership remains central to Paris, Accra, and Busan declarations, and exploring the varying definitions is vital to understanding a critique of how ownership has been deployed in the aftermath. The Paris definition of ownership is when "partner countries exercise effective leadership over their development policies, and strategies and coordinate development actions and donors' respect partner country leadership and help strengthen their capacity to exercise it" (Collins, 2011, p.). The Accra Agenda emphasized "*local* ownership" to reduce transaction costs (Ashford, & Biswas, 2010, emphasis added). The Accra Agenda led to ownership being defined as "the extent to which priorities are backed by budget allocation and by confronting difficult policy and program choices which will determine whether the program can be implemented'' (Smith, 2005). Consistently, definitions of ownership feature top-down approaches to ownership-as-outcome instead of ownership-as-foundation that seek modalities for "implementing" ownership instead of accepting it as fact.

In defining ownership, donors choose between "country" and "government," "democratic" and "inclusive," and "local" and "national" (Woll, 2008). These choices point to the conflicting nature of ownership in aid—something that is inherently internal but is expected to be built using external funds (Collins, 2011). Both the OECD and World Bank in the early 2000's asserted that development financing has "generally failed to produce lasting change" because of the lack of real ownership (Collins, 2011). Resolving this conflict is not impossible, but it does require external funders to understand that, even with good intentions, enacting ownership can restrict progress when done without recognition that recipient nations have all the tools they need for ownership and progress to follow.

Quality & Ownership in Aid

Ownership in education stands to improve not only aid relationships between donor and recipient nations but can also affect school and classroom quality. In the 30 years since the 1990 Jomtien Education for All (EFA) conference, the world has seen notable progress towards achieving Universal Primary Education (UPE). EFA Global monitoring reports boast child mortality rates are down 39%, 48 million more students are enrolled in primary schools, secondary school enrollment has nearly doubled in some parts of the world, and the number of countries with extreme gender exclusion rates has been reduced by almost half (EFA 2000-2015 Report Card, 2016). With more students in attendance than ever before, the donor community is increasingly concerned with the "learning crisis" in a disproportionate number of classrooms in low and middle-income countries where students can spend years in school and never learn to read or write (World Bank, 2017).

On average, nations in the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) community spend the largest percentage of domestic budgets on education, but their relatively low GDPs and overwhelmingly young populations make domestic spending insufficient and international aid a near necessity (Gakusi, 2010). The next section explores the quality crisis in terms of defining, providing, and funding quality from the perspective of the donor community and the SACMEQ, southern African nations where large numbers of ultra- and extremely poor are located.

While southern African countries are diverse in many ways, their education systems face similar challenges, and donor strategies within and across their borders are similar. In response to the diversity of SACMEQ member-states, SACMEQ assessments are designed for multi-level analysis, showing clear impacts of socioeconomic status, gender, and grade repetition across

nations, and providing realistic suggestions for policy adjustments to both donor and recipient communities.

Wanzelu Ndani?

When Chewa communities in Zambia were asked *"wanzelu ndani?"* they responded that intelligence, as they understood it, was a mix of cognitive skill and social responsibility, it was not time-bound, and had little to do with demonstrating ability to solve paper formulas (Serpell & Simatende, 2016). USAID Early Grade Reading Assessments (EGRA), which marked answers wrong when they were not given within the allotted time period, were at odds with a Chewa culture that valued slow responses over fast responses and with data analysis that assessment response rate does not coordinate with comprehension in Africa (Serpell & Simatende, 2016). Still, shockingly low EGRA performance in Zambia set off a wave of conversation about classroom quality and the donor community and Zambian government began anew the discussion on how best to ensure students were learning. At odds in the Zambian example, and other SACMEQ nations, are clear connections on what exactly defines a quality education between the donor community and recipient population. There is no room in the above example for the SACMEQ governments to own how education is defined. Until ownership principles are advanced, and the quality question is determined, education and development cannot work together to achieve conflicting goals through assessment, projects, or increased funding.

Quality and Neoliberalism

The SACMEQ nation's perspective on defining quality in education is complicated by a colonial history and poor domestic governance. As Moore argues, education is a "public good" not in the sense that it is "non-rival and non-excludable" but because the public defines what "good" means for themselves and society as a collective (Pritchett, 2017). At independence,

SACMEQ nations inherited school systems that were exclusive, segregated, and built to serve the needs of colonial governments.

In SACMEQ nations where "Big Man" leadership is defined by personal patronage networks, the "public" defining educational worth or "good" is usually the donor community and not citizens of recipient countries (Moss, 2007). Liberal egalitarian views of education that promote equal distribution of educational opportunities and radical humanist views that call for social transformation and Freirean pedagogy promote education based in indigenous knowledge of technology and farming is at odds with donor countries needs for assessment and immediate accountability to their constituencies (Dembélé & Oviawe, 2007).

In Malawi and other SACMEQ nations, authoritarian leaders perpetuated the use of Eurocentric and irrelevant curriculums, teacher-centered pedagogy, gender exclusion, and the liberal use of corporal punishment (Tikly, 2010). When Banda left the Malawian presidency in 1994, educational exclusion remained, and Bakili Muluzi, Malawi's first democratically-elected president, called for Free Primary Education (FPE) to begin with the next school cycle. FPE came to Malawi to allow Muluzi and his elites access to the vast amounts of aid money that came with the declaration, not to ensure the dismantling of Banda's tight control on individual progress and access to quality education (Kendall, 2007). In today's Malawi, a three-tier education system ensures that only the select few receive an education that coordinates with any broadly defined view of quality (Gakusi, 2010).

Even SACMEQ ministers of education adopt the economic definition of education quality, citing "examination systems, policy, and administration" as indicators and rejecting domestic pushes for more sustainable and immediate definitions associated with curriculum relevance and links to labor markets. In 2003, a SACMEQ minister of education responded to

low performance data with outrage about a potential “punishment posting” as fallout from the results saying that SACMEQ researchers “sometimes forget we are politicians” and that the minister's development agenda is aligned with party manifestos which promise to donors they would provide “free and compulsory” education—quality was far from their minds (Murimba, 2006). The ramifications of external and political motivations for defining education quality is evident in SACMEQ nations where 25% of annual educational expenditure is consumed by grade repetition and drop-out of students who cite an irrelevant and uninteresting curriculum as a top reason for leaving (Dembélé & Oviawe, 2007).

The donor community's reliance on economic outcomes and high-stakes test scores to define what a quality education should result in, and the willingness of SACMEQ nations to accept this definition in exchange for aid, does not make the “how to achieve quality” conversation any easier or less complicated. Discussions on capacity development, teacher training, textbook provision, and infrastructure projects illustrate the disconnect between donor community plans for increased quality and their reception. Donors have utilized privatization, decentralization, electronic management information systems, robust national exams, and curriculum overhauls in attempts to improve quality in SACMEQ nations with debatable results (Hanushek et al, 2008). Generally, SACMEQ nations have responded that these initiatives lack attention to country context and proper implementation plans while relying on anecdotal information and the facade of recipient country buy-in (Riddell, 2012). Of course, the donor community takes on risks in provision of budget support and country grants which can be subject to corruption and misallocation at local, regional, and national levels, evidenced by the $36 million missing in Malawi’s Cashgate and the $46 million missing from Kenya’s Ministry of Education in 2011 (Lee & Zuze, 2011; VOA, 2011).

Quality & School Construction

Decisions on how to improve quality rest largely with the donor community, which is itself at odds about "what works" in improving academic outcomes. The range of tactics used by donors to improved education is wide and many are openly criticized. Early development work believed that in SACMEQ nations the school was more influential in predicting student achievement than family background—this notion led to substantial investment on hardware for schools, particularly primary schools (Riddell, 2012). The World Bank and African Development Bank portfolios show that assistance to SACMEQ countries before mid-1990's overwhelming went to physical goods for primary schools (books, infrastructure, material support), dropping below 50% only in 2004 (Gakusi, 2010). School building is an effective means for donor nations to advertise their goodwill and account for expenses, but in recipient nations, it fails to address systemic problems.

A review of USAID policies showed quality improvement plans in SACMEQ countries were repeatedly undermined by disregarding country-level needs and whole-systems support or context (Gillies, 2010). When the donor community promoted contract teachers and double-shifting in SACMEQ schools, increasing access without the price-tag for constructing new schools, recipient nations saw declines in learning outcomes and, already low, teacher morale (Riddell, 2010). World Bank projects in SACMEQ countries marked projects as "successfully completed" when textbooks were delivered to schools instead of after the process of training teachers on how to best utilize the materials (Nielson et al, 2006). Quality improvement in schools requires expensive, sustained change that is at odds with donor's needs to monitor and evaluate at every stage.

Funding Quality

The power imbalance in deciding how to improve quality is mirrored in issues with how to fund a quality education. Despite agreement from both donors and recipient nations that project aid undermines system-wide changes, this type of aid was still 48% of all ODA to education in 2010. The Global Partnership for Education (GPE) often advertises their commitment to using "aligned" aid, but Zambia was the only SACMEQ country that showed a positive alignment of aid with recipient systems in 2010 (Riddell, 2012). Global funds are not the only donors guilty of ignoring systemic issues; an African Development Bank Report in 2000 indicated that their projects lack coordination with the broader development community, included little or no consultation with stakeholders or beneficiaries, and were plagued by high costs (Gakusi, 2010).

Likewise, project aid and Randomized Control Trials (RCTs) offer fiscal control to the donor community but often create "islands of excellence amidst seas of disadvantage", ignoring the larger system and usually proving impossible to scale up (Riddell, 2012). The trend of "big bang" support from the donor community for enrollment expansion, fee abolition, and automatic promotion came contrary to country-level pleas that donors support more schools at the secondary and tertiary level and fund "soft" projects like recurring costs and staff salaries.

SWAPs

Sector Wide Approaches (SWAPs) emerged in response to the criticisms of project-based aid and, while not perfect, are approached and received differently by individual members of the donor and recipient communities. For donors, SWAPs are touted to improve inter-governmental relationship, increase the percentage of "on-budget" aid, and make education more accessible to larger proportions of recipient nation populations (Riddell, 2012). The Partnership General Budget for Support (PGBS) developed under SWAPs in SACMEQ nations saw varying results;

Malawi's initial plan resulted in a "false start" and poor strategy while Uganda benefited from higher "pro-poor expenditures" and higher quality essential services (Riddell, 2012). SWAPs are often sub-sector wide instead of sector-wide and contribute mostly to projects at the primary level while ignoring secondary and tertiary institutions. SWAPs require some donor coordination, but these conversations usually leave out key recipient stakeholders and are imposed top-down in SACMEQ nations (Riddell, 2012). Recipient nations also note that SWAPs suffer from lack of country context, lackluster understanding of country politics and incentives, and little to no country buy-in. Under SWAPs, "capacity development" from the recipient perspective is often mass trainings and a daily stipend, not a true knowledge transfer (Riddell, 2012).

Multilateral Funds

Recipient nations have largely maximized domestic spending on education, and the need gap is filled by donors who have great power in influencing the education agenda through funding. Due to the highly centralized and weak-management characteristic of SACMEQ member nation education systems, funding decisions are often allocated based on donor convenience and expediency of delivering performance indicators (Gakusi, 2010). The multi-donor GPE was established on the premise that "no country with a credible plan would be thwarted from implementing it for a lack of resources" (Riddell, 2012). While the commitment is morally noble, the loose definition of "quality" discussed above means that the donor community and recipient nations can pour resources into "proven plans" more for political trade-offs than demonstrated educational effectiveness (Grindle, 2010). Even when SACMEQ nations are opposed to a donor's philosophy, they are hindered from effectively altering donor plans due to ever-changing norms in donor agencies, pseudo "partnership" rhetoric, and the preclusion of

national ownership and local control innate in donor organizations (Samoff, 2007). With so many donors acting in SACMEQ nations, funding is spread wide and not always coordinated through recipient government mechanisms. The donor community has yet to pledge substantial resources to scale up the most successful finance projects such as conditional cash transfers or cash on delivery schemes, which are not without their own criticisms.

In SACMEQ countries where rural posts go unappointed, urban teachers are frequently absent, and large numbers of unemployed youth go without basic numeracy and literacy skills, the quality crisis is very real. Quality concerns will likely dominate international education headlines, particularly those in South and East Africa, for the foreseeable future, but the topic is not new. Donors and recipient countries are both responsible for the contradictions, faulty policy, and weak implementation that feed into the quality crisis, and the power balance is currently heavily tilted in the donors' favor. Advancing ownership principles can be vital in tipping the scale.

For decades, aid-recipients and donor communities have danced around the definition of quality, strategies for improving educational outcomes, and the best funding mechanisms—both parties recycling strategies and rhetoric in place of actual compromise or conversation—any end to the quality crisis will require increased recipient nation ownership, coordination, conversation, and compromise from both ends.

The clear need for increased ownership and quality in aid is abundantly clear in the physical manifestations of aid to education: school construction sites. In the next section, I introduce how Geospatial Information Systems (GIS) respond to aid and education and can be key to increasing access and quality.

GIS, Aid, & Education

> "The unity of all science is found in geography. The significance of geography is that it presents the earth as the enduring home of the occupations of man. The world without its relationships to human activity is less than a world (Dewey quoted by Brock, 2013, p. 277)

With rare exceptions, my alma mater, West Charlotte High School is the source of an abundance of negative attention in local and national news outlets. I speak this with a clarity that I have known for more than a decade; when North Carolinians hear "West Charlotte High School" they often reflect on the results of "academic genocide" that led Harvard's opportunity atlas to label Charlotte as the single largest American city where Black youth are least likely to find economic mobility (Chetty, Friedman, Hendren, Jones, & Porter, 2018; Mickelson, Smith & Nelson, 2017). West Charlotte is characterized as the place where busing, re/desegregation, unequal lending practices, intrusive highway systems, and a host of other systemic injustices come to meet for the destruction of black children and communities (Cook, 2019). Yet, there are other ways of knowing and seeing the histories, people, and physical buildings that make West Charlotte High and the community that surrounds it, not captured by these well-known tales.

A grounded theory use of GIS by Knigge and Cope (2006) uses mixed methods to explore community gardens in Buffalo, NY—researches combine quantitative data on existing gardens and qualitative ethnographic data from local communities for insights that are greater than the two data sets would have provided in separate contexts. A re/mapping that explores previously separate ways of knowing through spatial analysis and visualizations is at the heart of critical GIS, a methodology and theoretical lens that offers valuable lessons for international aid to education (Cope & Elwood, 2009).

A great deal of the salient topics in international aid to education are, at heart, issues of space and place—prioritizing girls' education, increasing attainment, reforming curriculums, and

expanding infrastructure can all be linked to the physical school grounds where these activities happen. Defining the physical school building that houses West Charlotte High as a location that is only home to destitution and poverty leads to a vicious cycle. The persisting idea that West Charlotte—or any other school—is a timeless manifestation of "academic genocide" without question, explanation, or qualification has resulted in the perpetuation of a single narrative of black Charlotteans. The same can be said of the equivalent labeling of nations and regions as "developing", "global south", or "third world." The danger in this automatic grouping is that neither history nor future is consulted; instead, the present-day situations are accepted at face value and perpetuated through a never-ending series of daunting statistics and tragic stories, all linked to one place.

Critical GIS, also known as qualitative GIS and non-quantitative GIS, is a field of thought situated in GIS and geography that engages with the technological structure of spatial analysis for new and powerful insights (Schuurman, 2000). In this section, I offer a review of the literature on critical GIS and GIS in Education as they relate to opportunities in aid to international education.

Mapping Schools as Successes and Failures

> "Little progress was made in understanding disease until technologies like the microscope gave scientists novel ways to understand biology…The end goal [in opportunity mapping] is the social equivalent of precision medicine: a method for diagnosing the particular weaknesses of a place and prescribing a set of treatments. This could transform neighborhoods and restore the American dream from the ground up. (Cook, 2019, p. 3)

The Opportunity Atlas' linking of education and medicine is not a new practice, but without care, it can be naïve and dangerous. Mapping schools as either successful or failures can easily downplay the lengthy and persisting legacies of racism and colonialism. Instead of recognizing past failures of local and national policy initiatives and learning from them, this

mapping can discount geographic and demographic oddities and on-the-ground realities. The insistence to label a school as pass or fail lends credence to the notion that a "failing" community and its' residents are the central issue, desperately in need of an external fix instead of the powerful institutions and legacies that placed them there.

There is no shortage of people and programs working to "fix" the Malawi or West Charlotte with seemingly endless amounts of money from state and private actors. Still, these initiatives will continue to fail if they do not recognize West Charlotte, Malawi, or any individual community as more than "victim of location" (Mickelson, Smith, Nelson, 2017). As Blaikie (1996) noted, "you must be very dumb or very rich if you fail to notice that 'development' stinks (as quoted in Dunn, Atkins, & Townsend, 1997, p. 7). With this warning I mind, I use the next sections to discuss how GIS can still work to positively impact aid to education.

GIS & Education

Geographic Information Systems (GIS) is best described as an originally capitalistic and militaristic "computer software to design maps and the spatial analysis of geospatial data" (Gieseking, 2018). Far from its militaristic origins, GIS today can play an essential role in how international aid to education is administered. For education specialist, GIS identifies three categories for visualizing school data; *lines*—journeys to school, post/pre-education centers, and migration; *points*—school buildings and school planning offices; and *surfaces*—education zones and clusters (Brock, 2013).

There is a growing body of educator/geographers that see beyond the militaristic origins of GIS towards a future where educational outcomes are enhanced through decision-making based on geospatial information (Yoon & Libineski, 2017; Filmer, 2007; Brock, 2013; Gieseking, 2018; Eldrandaly, 2013; Wiseman, 2010). Still, there are some barriers to this

crossover. Brock (2013) outlines the delayed entry of GIS into education as a result of three central issues; the reluctance of educators to use multilevel analysis; the imaginary dichotomy of comparative and international education as competing and separative disciplines; and misunderstandings of how education is conceived in the global south.

In "The Role of Place, Geography, and Geographical Information Systems (GIS) in Educational Research" Mann and Saultz (2019) call on educators to respond to the urgent need for educational research that is elevated through the inclusion of the oft-ignored geographic component of education. This call is echoed in powerful ways by other scholars in the edited journal which provides theoretical orientations for using GIS in education, methodological examples, and a diverse array of real-world implications (Cope & Elwood, 2009, Yoon, Gulson, Lubienski, 2018; Kelly, 2019; Waitoller & Lubienski, 2019; Bartanen, Grissom, Joshi, & Meredith, 2018).

The applications of GIS and new GIS methodologies such as qualitative and mixed-methods GIS in education are seemingly limitless. Recent research combining education research and new GIS methodologies has been used to explore residential segregation in metro St. Louis school districts (Hogrebe & Tate, 2019). Green, Sanchez, & Castro (2019) use hot spot spatial analysis to trace patterns in Detroit public school closures and new charter school openings. GIS has also been used to understand enrollment patterns in universal pre-kindergarten and patterns of new racial segregation practices in a spatial analysis of southern school district successions (Shapiro, Martin, Weiland, Unterman, 2019; Taylor, Frankenberg, & Siegel-Hawley, 2019). The collective voices of these GIS educational researchers indicate that the once daunting technological and financial barriers to entry for education researchers are no longer the

impediments they once were and that the time for incorporating spatial analysis in educational decision-making is now.

GIS is a tool—it can be used to control, disempower, and disenfranchise a people but it can also accurately display and triage the locations of high-risk populations when those who wield it avoid the trappings of power and quick "technofixes for development" (Dunn, Atkins, & Townsend, 1997). Whether in Charlotte, NC, or Lilongwe, Malawi, for those who are willing, GIS can prove to be a useful resource to direct future policy, highlight structural inequalities, and bring to light social-spatial phenomena for the sake of justice. Below, I will briefly outline the nascent Critical GIS field and its connections to education in Malawi.

Critical GIS

Rejecting the traditional use of GIS by powerful groups such as the United States Armed Forces, Critical GIS enlists an ontological, methodological, and epistemological stance that is neither inherently quantitative nor exclusively positivistic (Schuurman, 2000; Yoon & Libineski, 2017). Critical GIS grew out of a reflexive process of geographers and GISer's in the 1990's challenging the assumption that because GIS is a computer-based software and computers are digital in nature, research utilizing GIS must concentrate on numerical data and numerical data alone (Schuurman, 2000; Kwan & Knigge, 2006; Wilson, 2009). Schulman's (2000) call for GIS researchers and practitioners to engage with love and feminism in criticism of GIS methods was foundational to the Critical GIS and qualitative GIS methodologies that will be critical in successfully combining GIS and Education research for findings that empower underserved communities and provide actionable insight for policy makers.

GIS is a flexible tool that can be used to represent both the quantitative data behind geographical features and the qualitative data that responds to meaning and existence—the result

of combining these different sets of data are dynamic visualizations that are neither static nor two dimensional (Crampton, 2011).

Current applications of GIS in education are limited to quantifiable social and racial demographics, derived mostly from census data on population descriptions, student mobility, and school choice outcomes (Yoon & Libineski, 2017). The potential for GIS as an educational tool is endless because of its ability to be easily updated, scaled, and adapted for varying contexts (Yoon & Libineski, 2017). Below I discuss how Critical GIS responds to evidence use in education and contextualizing policy.

GIS & Context

"Mapping is itself a political act" (Crampton, 2010, p. 9). All maps are social constructed—Critical GIS posits that involving paradigmatic and epistemological traditions from other disciplines can complement the field and enhance findings, decision-making, and meaning (Yoon & Libineski, 2017). West Charlotte High School has been mapped, on paper, and in minds, using a particular set of identifiers. In a similar manner, Malawi has been mapped to represent one thing to IAOs, a problem. Malawi's location is presented as static and its name synonymous with poverty, hunger, need, and deficiency. Instead of focusing on the people and places within the country's borders, the single story of Malawi is represented through dire statistics. This creates a vicious cycle where even well-intentioned researchers and policymakers repeatedly follow the paths designed by others. The cycle of repeating narratives is particularly dangerous in neoliberal institutions where policymakers and researchers can choose to ignore individuals (Adichie, 2009; Yoon & Libineski, 2017). Critical GIS seeks to empower other ways of knowing through data visualization and spatial mapping.

While I am intimately familiar with how West Charlotte is received by those who do not know the school, I am also aware of the many other ways of knowing and placing the school and surrounding community—through the music-filled halls, overly dedicated staff, countless championships, and loving families. What would happen if school report cards also reflected "what is *working* here?" instead of a simple pass/fail? Critical GIS does not immediately solve the problem of representation, but it does allow for an exploration of alternative narratives by not limited visual displays to quantitative data (Yoon, Gulson, & Libineski, 2018). I use MMGIS case study because of the potential it holds for advancing ownership principles for IAO's in Malawi and throughout Africa.

Evidence & Context

Context is living, breathing, and ever-changing. There is not one "African" or "Malawian" context—the constant need for contextualizing the work of IAOs requires tools as dynamic as GIS (Green, 2015). Still, powerful evidence-based tools can be dangerous and serve as blinders to researchers, evidenced in the United States by the "What Works" debates and ramifications of the Coleman Report (Carnoy, 2012; Ravitch, 2000). In Malawi, the evidence judged is often high-stakes summative test scores, which can be unreliable and unfair measures of student achievement, particularly outside of the American context (McCowan & Unterhalter, 2015). The Primary School Leaving Certificate Examination (PSLCE) is the single test that will determine if a Malawian can enroll in secondary school—all eight years of prior learning are linked to a high stakes test where students can be subject to outdoor testing, testing without access to electricity, interfering noise from other grade-levels and other distractions that would automatically disqualify results in the United States. Test-scores alone cannot accurately

represent an individual's propensity to succeed or fail, and they should be interpreted with extreme caution in context where the testing environment can be easily compromised.

Evidence-based policymaking can be used to measure educational quality and maintain quality, but it can also be weaponized to control learners, communities, and societies (Wiseman, 2010). There are reasons to be wary of data-based decision making in education. While some policymakers claim to be targeting quality, they often overlook flaws in the data, that test scores can be unreliable, and the unintended consequences of linking school resources to test scores (Wiseman, 2010). Denial of the limitations of evidence-based decision making is rampant in the IAO community; the single-story narrative is often recycled in transnational communities of policymakers and consultants who share common beliefs about what defines the "problem" of education and what pre-established "solutions" can be deployed (Wiseman, 2010). Evidence can be weaponized to describe a "quality" that is internally defined and validate the beliefs and narratives already held. GIS allows for a more nuanced and ever-changing definition of how communities are seen and what IAO interaction within them can be.

In this chapter, I reviewed the history of international aid to education, theories international aid is rooted in, and challenges facing the industry as a whole. I also discussed the challenges of receiving and administering aid. I reviewed how advancing ownership principles might offer a solution to advancing aid in Malawi and to ultra- and extremely poor populations in Africa. I also covered the potential GIS holds for the field of education, particularly in historically marginalized communities. In the next chapter, I focus on aid in Malawi and offer I brief history of aid and education in the country before using Chapter 5 and 6 to outline a case study on aid practices in school construction.

CHAPTER 3: A PARTIAL AND SITUATED STORY OF AID IN MALAWI

Introduction

Thus far, I have explored who the major actors in international aid to Africa are, how they have shaped educational outcomes in Africa, and what their motivations and rationales are. In this section, using Malawi as an example, I will discuss how historical legacies of international aid are evident in the education sector today. As one of the poorest countries in the world, Malawi is an anomaly in sub-Saharan Africa; the nation has never been at war, historically receives high levels of aid, and its government has generally followed the instructions of IMF experts without pushback—still, the nation has yet to realize the promises of human capital theory which were the theoretical groundings for the aid and advice of global north specialists.

In detail, I work against Wainaina's (2005) satirical plea to blame the West for Africa's situation "but do not be too specific" by offering demographics on the geography and social indicators of Malawi, followed by a chronological history of education, and ending with a brief discussion on how aid mechanisms enforce the global north/south order. The aid economy and policies from the global north have shaped Malawi's education system to detrimental effects.

General Background on Malawi

Geography

Present-day Malawi is located in southern Africa, bordered by Mozambique, Tanzania, and Zambia, and is one of the smallest nations in Africa. Malawi is landlocked and relatively narrow, with a maximum width less than a third of the country's length. It is slightly smaller than

Cuba in area. Located just below the equator, Malawi's climate is subtropical: an increasingly sporadic rainy season between November and February peaks in January when farmers begin planting crops; February to March is known as the "hunger season" when food supplies are low and economic activity is dampened; harvesting begins in April and national crop yields determine how the months until planting season will be spent (Holland, 2010). Plateaus and plains define Malawi's terrain with notable hills and mountains on the eastern border, which splits the Great Rift Valley; most rivers are seasonal and dry up in the winter months from May to August.

Malawi is divided into three geographic and political regions: north, central, and south. Southern Malawi is the most populated region and contains Blantyre, the commercial hub of the nation. The central region features the capital, Lilongwe, situated on the broader Central African Plateau. The northern region is the least populated area with the highest elevation.

Lake Malawi, formerly Lake Nyasa, covers nearly a third of the nation's area and is located on the northeastern border shared with Tanzania and Zambia. Lake Malawi contains more fish species than any other natural lake on earth, and international tourism and ecological studies in the lake region are an additional source of income and national pride. Ownership of the lake is the source of Malawi's sole international conflict due to potential underground oil reserves; Tanzania argues the border is in the center of the lake while Malawi places the edge at Tanzania's western shores.

Figure 3. Political Map of Malawi. Retrieved from http://www.emapsworld.com/malawi-political-map.html

Socioeconomic Indicators

In Malawi, overall statistical capacity, the level at which the World Bank certifies data as statistically reliable, in Malawi is at 75.6 points on a 100-point scale—far higher than other low income and sub-Saharan African nations (World Bank, 2010). Data on Malawi from different agencies vary across indicators for the same years. Due to global north and human capital theory dependence on data, there is a need to be cautious of the validity of statistical measurements (Arnove, 2012).

I discuss indicators of socioeconomic status in Malawi to provide context for the political discussion on education that follows. Development specialists are generally perplexed by the "failure of aid" in the country; historically, high poverty levels have been used to justify unusually high levels of international intervention that fail to have much success (Easterly, 2006). These indicators do not—cannot—tell the history of Malawi without being understood in the context of other systems that work to maintain the global north.

The population of Malawi is 18 million, with 80% residing in rural areas (Malawi, 2016). Malawi is an extremely young country with over 60% of the population under 25 years old, while eight million people, or 47% of the overall population, are under the age of 15 years (Malawi, 2016). Nearly 60% of the land is available for agricultural use, and subsistence farming is the main occupation for more than 80% of the population (World Bank, 2010). Agriculture accounts for a third of GDP and nearly 90% of the nation's exports. Tobacco, sugarcane, corn, tea, coffee, cotton, and potatoes are staple crops in the country.

Malawi is home to diverse ethnic and religious groups that peacefully coincide and intermarry. The major ethnic groups include Chewa (33%), Lomwe (18%), and Yao (14%) (Malawi, 2016). English is the official language, but Chichewa is used for daily life and widely spoken along with Chiyao and Chitumbuka (Malawi, 2016). Religiously, Malawi is 83% Christian and 13% Muslim, with a small percentage of the population practicing other religions (2%) or non-religious (2%) (World Bank, 2010).

The World Bank classifies Malawi as a lower-income country with a Gross Domestic Product of $4.25 billion. GNI per capita is $250 compared to $53,750 in the United States (World Bank, 2010). The GNI per capita is far below other sub-Saharan African nations; Malawi is one of the poorest countries in the world, and concentrations of ultra- and extremely poor are unusually high (World Bank, 2010). The Bottom Billion concept and its solutions are based partially on Collier's (2007) experiences traveling and working in Malawi.

History of Education in Malawi

Similar to most African states, the history of education in Malawi is distinctly political. Access to education was used to solidify power and reward obedience, not only in the colonial contexts, but as far back as the early 1800s.

Malawi operates on an 8-4-4 system, inherited from the British during their colonial rule: eight years of primary school, followed by four years of secondary school, and four years of tertiary education. In 2013, school enrollment rates were at 141%, with extremely high rates of grade repetition and the constant inclusion of older (+18) populations (Malawi, 2016). According to the Sustainable Development Goal progress report (2016), net primary enrollment (excluding grade repeaters) is at just 79%. Attainment rates for anything beyond primary school are severely limited by available capacity in schools and quality of instruction; only 64% of students who begin Standard 1 will reach Standard 5 (Rose, 2005). The male to female ratio for enrollment in primary schools was at 1.01, but that gap is .85 at secondary schools (UNESCO, 2014). At the tertiary level, the University of Malawi has capacity for 0.3% of eligible students—private universities are severely limited in number, but do exist (World Bank, 2010).

The social and historical events that contribute to the current state of Malawi's education system are discussed below. My discussion is limited by the availability of records for each period—education in Malawi did not begin with colonial intervention, but the records of Christian missionaries are readily available because of the same systems that sustain the global north hierarchy. Human capital theory and aid interventions are not the only reasons for the limited nature of Malawi's educational system, but they have historically worked in conjunction with corrupt government elites to contribute to the inequitable nature of education in Malawi.

Colonial Period

The first instances of a recorded formal education system in present-day Malawi are from accounts in the Northern region made by missionaries in the early 1800's (Kendall, 2005). These educational systems focused on reading and writing, mostly to inoculate Malawians with Christian values and teachings (Power, 2010). The focus on Christian values in education

isolated Malawi's Muslim population—which had formed, mainly in southern Malawi, as a result of pre-colonial trade and slave routes along the lake (Power, 2010). The exclusion of non-Christian citizens is still evident today and is cited in explanations of the relatively low achievement rates in southern district schools, lack of belief that schooling matters in southern districts, and the proliferation of bible colleges and Christian-sponsored schools across Malawi (Kendall, 2007).

In 1883, when the British officially established colonial rule, the curriculum remained primarily focused on reading and writing, but the exclusionary nature of educational opportunity was extended beyond religious differences. To maintain colonial rule, British administrators intentionally provided or denied access to education to certain Malawians based on tribal affiliations to maintain colonial rule (Power, 2010).

Banda's Rule

The Malawi Congress Party, responsible for ending British colonial rule, sought the British and American educated Dr. Hastings Kamuzu Banda to serve as the first president of independent Malawi, believing his extensive education credentials would legitimate the newly independent state (Englund, 2006). In 1958, Banda left the United Kingdom and returned to Malawi, promising universal education and freedom from colonial legacies. An attempted coup in 1965 ended any plans for universal access to education, and Banda subsequently appointed himself as Minister of Education and maintained a restrictive and elite system that favored males from the central region for the entirety of his 30-year autocratic rule as president (Kendall, 2007).

As head of the Ministry of Education, Banda outlawed private primary and secondary schools, institutionalized a limited curriculum that focused on multiple-choice and true/false

questions, and solidified regional divisions between the north, south, and center of the country (Kendall, 2007). The legacies of Banda's autocratic rule remain hyper-present in Malawi's education system and were made possible partly due to international aid from the global north.

The 1961 United States Foreign Assistance Act created long-term funding for economic and social development in education and other sectors. Section 116 promises to withhold aid from any nation that "engages in a consistent pattern of gross violations of internationally recognized human rights" (United States Congress, 1961). Despite this, Cold War foreign assistance in Malawi, and throughout Africa, provided decades of financial support for corrupt regimes. One of USAID's earliest projects was the funding and construction of the University of Malawi, and while the need for tertiary education in Malawi did exist, the US Government was aware that access would be limited and only serve to perpetuate social divisions (Kamara & Marriott, 1983; ACE, 1964).

USAID was instructed by the Government of Malawi to build a university that produced citizens, not leaders—a university that reflected the model of agricultural and technical schools rather than liberal arts universities in the United States (Holland, 2010). The effects of a higher education system that was initially designed for limited access and dependence on international aid remain present: professors for the university were provided by British and American universities and Malawians were rarely trained or promoted as full professors; partnerships with global north universities required foreign study and scholarships, leading to high levels of brain drain; and O levels, lower-level British examinations, were used as admission tests instead of the more highly regarded A levels, thus lowering admission criteria and the potential for regional coordination and research centers in southern Africa (Holland, 2008; Zdravkovic, Chiwona-Karltun, & Zink, 2016; Ashley, Williams & Ingrum, 2009).

The US did not suspend aid to Banda until 1993 when the end of the Cold War meant African allies were no longer politically useful. By that time, the social inequalities Banda had institutionalized through education were already solidified (Ajayi, 1996; Baker, 2006). The legacies of a university system designed to serve the needs of the global north meant that when international aid funding stopped, growth of the university system in Malawi was effectively halted, and access to higher education in the nation continues to suffer from underfunding and a weak foundation (Sawyerr, 2004).

Post-Democracy

In 1994, the first multi-party elections in Malawi signaled the end of Banda's rule, and Malawi's presidential candidates offered a range of promises for directing change and progress. Bakili Muluzi won the election on a platform of promises that included a free pair of shoes for every citizen, along with free housing, electricity, fertilizer, and education (Englund, 2006). Muluzi conveniently forgot many of his pledges after his inauguration, but free primary education was declared as law starting in 1995 (Kadzamira & Rose, 2003). When schools began classes the following year, enrollment doubled without the trained teachers, textbooks, or infrastructure to support the growth (Love, 2005). As was the case under Banda, the partnership between the Government of Malawi and aid organizations was designed to systematically limit educational attainment at every level of society, except for the elite few. The development of the aid economy ensured substantial overhead costs and an unresponsive structure, that was virtually incapable of adapting to changes or the desires of the Malawian citizens (Nwomonoh, 1998; Moyo, 2009). To fulfill aid requirements, Malawian teachers and staff were made to complete paperwork and administrative tasks that took away from instructional time (Minnis, 1998). Aid workers and global north organizations promised Malawian teacher's salary raises that never

came (Minnis, 1998), while Malawian government officials benefited from pilfering the large amount of aid dollars that came from EFA and global north organizations claimed the moral high ground for providing access to primary education. In reality, free schooling under these circumstances remained a myth for most of the nation (Kendall, 2007).

There were additional obstacles built into the system that did exists. The post-democracy development policy favored English as the language of instruction, essentially a foreign language for most Malawians, serving to further limit educational attainment and solidify the power of the educated elite (Kamwendo, 2008). Leaders of political parties were repeatedly appointed as chancellors of major universities in Malawi, which tended to limit professors' freedom of speech (Ayee, 2016). Patronage systems of appointing political figures to teaching and administrative posts left lasting legacies in Malawi and across the continent, including unequal workloads for assistant professors and younger staff, low department morale, and a lack of collaboration between colleagues due to distrust (Sawyerr, 2004). Yet another obstacle to education was that learning standards, primary and secondary curriculum, and textbooks were imported from the global north by international NGO's, not designed or printed locally. Therefore, the material did not promote innovation or creativity. For example, when agriculture was introduced as a standalone subject at the primary level, the curriculum was cited as general, useless, and levels below the knowledge students had already gained from their experience in the field (Msiska, 1998). No matter—the education system principles were in many ways, similar to Banda's: there is always only one right answer.

The education system in Malawi today primarily reflects these many colonial and post-colonial legacies of limited access, irrelevant curriculums, and empty promises for growth. Guided by human capital theory, international aid organizations have piloted a number of

strategies in attempts to reshape the system, but the collaboration with corrupt governments has seen most of them fail.

Aid & Ownership in Malawi

Banda and Muluzi hold considerable responsibility for the underdevelopment of Malawi's education system, but they were not thwarted by an aid system that was never designed for local ownership or control of education in Malawi. A Ministry of Education, Science, and Technology (MOEST) representative in 2010 said of ownership that "government and donors should walk on this path side by side and not in single file. The problem of walking in single file is that we do not know what is happening behind us" (Collins, 2011). Where funds are restricted and budgets are heavily aid-dependent, public expenditure is less important; the government is incentivized not to finance itself but to support the activities of aid organizations (Ohno & Niiya, 2004). This system does not encourage the government of Malawi to embrace responsibility for or ownership over the education of its citizens, but enables it instead to rely on global standards and indicators. Faced with results that are less than anticipated, global north donors' shame and patronize government officials instead of questioning the motivations and systems of international aid, then go on to intentionally design programs and projects that leave little room for collaboration (Sjöstedt, 2013). In this section, I explore how global north methods for distributing aid have produced systemic issues in Malawi, even after the end of autocratic rule.

Global north aid organizations prevent the Government of Malawi from "owning" its education system, even as aid workers deny doing so. Critiques of ownership in the relationship between donors and recipient nations can be summarized in terms of "donorship." Donorship is an understanding that mechanisms for country ownership were designed and implemented under the competing demands of donors in a relationship that is inherently unequal (Collins, 2011).

Under donorship, the Government of Malawi seeks a marginalized, indirect path to ownership by undermining or alternatively funding priorities according to larger political objectives and not solely internal need—such as the use of Chinese loans and grants to construct six universities rather than respond favorably to global north donors advocating for primary education over tertiary institutions (DaSilva, 2011).

Without care, ownership in aid to education, can be reduced to rhetoric and restrictions, evidenced by the MOEST representative's closing comments on ownership during the opening statements of a Joint Sector Review: "You may get amazed when you decide to turn back, and see there is no one behind you" (Collins, 2011). In my own experience in Malawi, I had several conversations with development partners where "political will" was cited as the root cause of development's failure in Malawian education. Discussions typically reflected on the nation's peaceful history, note the billions of dollars of aid it has received, and conclude that the Government of Malawi simply must not want it enough. There was minimal discussion that ownership had altogether been falsely defined and inappropriately implemented. Aside from the fact that this argument is not entirely situated in history, it suffers from the failure of largely ignoring donor responsibility.

Project Aid & Technical Assistance.

Aid organizations respond to the Government of Malawi's circumvention strategies by implementing aid through systems that do not require Malawian input, such as technical assistance and project aid, both of which constitute large chunks the of aid money spent by global north economies (Samoff, 1999; Bizhan, 2016). The European Union, historically one of Malawi's largest funders, does not promote ownership because of the EU's "excessive preoccupation" with demonstrating its ability to commit and spend money quickly; the

government of Malawi moves too slowly for the aid organization (Carbone, 2008). Reviews of USAID practices found they undermine ownership because of "US skepticism of [the Malawian] government" (Riddell, 2008). Project aid, a symptom of fragmentation, rejects ownership because individual projects are challenging to incorporate into existing policies and programs beyond the level of rhetoric (Ohno & Niiya, 2004). Likewise, Technical Assistance often misses the mark in encouraging recipient ownership (Smith, 2005). In the struggle to get funding, recipient countries downgrade their own priorities and embrace the various procedural requests by development banks and bilateral funders (Smith, 2005).

Sector-wide Approach & Direct Budget Support

Use of direct budget support (DBS) and sector-wide approaches (SWAPs) meant to encourage recipient ownership have, in some ways, hindered progress because they require high levels of donor involvement in planning and budgeting (Ohno & Niiya, 2004). SWAPs were created in response to the criticism of project aid and were designed to emphasize government ownership, but they have been unsuccessful. In Malawi, an education development partner remarked that "The whole SWAP process really is a process that is driven by development partners" (Chirwa, 2012). When the Government of Malawi developed country-wide plans for two years of in-classroom teacher training and presented them to donors, development partners altered the design to fund only a portion of the training while using the majority of the funds for Teacher Training Colleges that could be branded with aid organization logos. This was all despite evidence-based assessment and insistence by the government of Malawi that deployed teachers needed training, encouragement, and support (Chirwa, 2012). Due to the power donors have in allocation and budgeting, SWAPs can still undermine ownership. For similar reasons, DBS, does not always lead to increased ownership because it is subject to more dialogue with

donors, and Malawian officials often leave negotiations with few of their desires met (DaSilva, 2011).

Aid overwhelmingly treats ownership as a constructed outcome instead of outright fact (Booth, 2012; Freire, 1970). For actual progress in ownership, the connections between donors and government must be strengthened under a Freirean pedagogy. The same must be done in regards to donor relations with NGOs, researchers, and civil society to increase ownership at every level, moving from an unbalanced extraction of resources to real participation (Higgins & Rwanyange, 2005; Kendall, Kaunda, & Friedson-Rideneur, 2015).

This review has discussed the main ways global north aid to education in Africa is distributed, the failures of human capital theory, and the lasting legacies of aid on education systems in Malawi. Education is a powerful tool for strangling resistance, perception, and action; it has been wielded throughout history to grow, destroy, and merge nations by silencing citizens (Hobsbawm 1996; O'Leary 2003). This use of education was not lost on autocratic and self-serving government officials in Malawi, and it has not been lost on global north nations that benefit from the current world order. Still, a national system of education is a "living thing, the outcome of forgotten struggles and difficulties...It reflects, while seeking to remedy, the failings of national character" (Sadler, 1900, as quoted in Cowen & Kazamias, 2009).

In summary, this chapter addresses the history of aid to education in Malawi by providing context on the nation, a brief political history, and an overview of the types of interventions previously used by IAO's to address educational inequalities. If education in Malawi and throughout Africa is to be transformed through international aid, it will be necessary for global north aid organizations to rethink their motivations and mechanisms and for African

governments to take true ownership of education systems with the best interests of the world's ultra and extremely poor in mind.

In the next chapter, I use a mixed methods case study to explore how altering existing aid practices by implementing appropriate technology is one mechanism for designing aid solutions with ownership principles and target populations as key factors. In detail, I outline a theoretical framework and methodology for a case study analysis that compares the process for manually selecting sites for new school construction with GIS generated sites and how principles of ownership are advanced in each instance.

CHAPTER 4: METHODS

The intent of this research is to use a mixed-methods case study to explore best practices for IAOs interested in identifying optimal sites for new school construction through an examination of the procedures and outcomes of using GIS methods for site selection compared to using manual methods. Qualitative data will include my experience, GIS data visualizations, and relevant literature. Quantitative data for both the manual and GIS cases regarding the school site selection will focus on school-based results for standardized tests, aggregated by gender.

The methods and results for this study are heavily based on the results of one high-stakes test. While using this data offers analysis that will be aligned with IAO priorities, one year of test score data is an unfair measure for assessing schools, students, and teachers. The limited use of test score data feeds into a harmful narrative that annual assessments are the proper and only way to "measure success" in schools. Still, it is my intention that this research is viewed as an exploration of possibilities and that future studies incorporate indicators beyond test results. In this chapter, I describe in detail the research using the following sub-sections: research questions, theoretical framework, methodology, design rationale, and data collection and analysis.

Research Questions

Creswell and Clark (2018) note that mixed-methods research should include qualitative, quantitative, and mixed methods research questions, with the sequence of these questions reflecting the research design. This research utilizes a complex mixed-methods case study design with a convergent core, meaning quantitative and qualitative data are simultaneously collected. This mixed-methods case study design is necessary when using critical theories and when the research requires an in-depth practical understanding of a complex situation on both quantitative

and qualitative dimensions (Creswell & Clark, 2018). Determining how GIS could be integrated into IAO operations in Malawi and throughout Africa to ensure aid reaches the ultra and extremely poor is one such case that requires extensive knowledge of aid and development systems as well as process and procedures for selecting sites for new school construction.

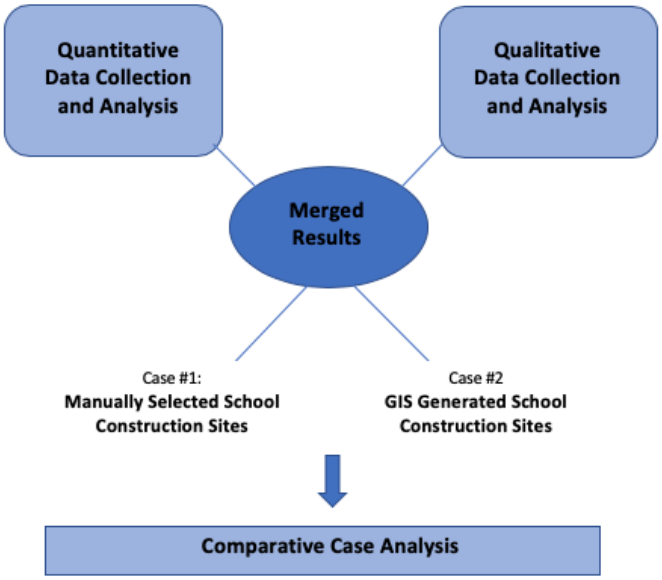


Figure 3. Mixed Methods Case Study Design.
Adapted from "Designing and Conducting Mixed Methods Research" by Creswell and Clark, 2018.

Figure 3 offers a visual display of the major research methods of this dissertation: to simultaneously collect quantitative and qualitative data, merge results, then use side-by-side comparative case analysis. Below I list my research questions in terms of overarching questions for this mixed methods study. I followed by sub-dividing qualitative questions, quantitative questions, and integrated questions.

1. How do GIS generated sites compare with manually selected sites for new school construction in terms of expanding opportunities for local ownership in future school construction?

a. What is the history of international aid to education in southern Africa and Malawi?
b. How can GIS data analysis be employed to assess land for new school construction?
c. Do GIS analytical methods validate or contradict the use of manual methods for selecting school construction sites by International Aid Organizations (IAO's)
d. What are the implications of the above for future school construction projects by international aid organizations in Malawi and throughout Africa?

Qualitative Research Question:

- How do ownership principles influence international aid to education in southern Africa and Malawi? (Answered in Chapter 3)
- Where are opportunities for advancing ownership principles presented in the GIS process compared to the manual method? (Answered in Chapter 5)

Quantitative Research Question:

- Using manual selection methods, which sites are best suited for new school construction in Malawi? (Answered in Chapter 5)
- Using GIS selection methods, which sites are best suited for new school construction in Malawi? (Answered in Chapter 5)

Integrated Research Questions:

- Do GIS analytical methods validate or contradict the use of manual methods for selecting school construction sites by International Aid Organizations (IAO's)? (Answered in Chapter 5)

- What are the implications of using manual or GIS data analysis for future school construction projects by international aid organizations in Malawi and throughout Africa? (Answered in Chapter 6)

In this section, I have outlined my research questions, and the sequencing of data collection for this mixed-methods case study design with concurrent data collection. In the next section, I discuss how performance studies can be a useful theoretical framework in understanding existing relationships and networks in international aid as well as opportunities to change them.

Theoretical Framework

> People who believe in fundamental and irreversible changes in human nature are themselves ahistorical and naive...individual citizens are internally plural: they have within them the full range of behavioral possibilities. They are like complex musical scores from which certain melodies can be teased out and others ignored or suppressed, depending, at least in part, on who is doing the conducting. (Smith, 2016, p. 4)

Performance Studies

Performance studies is based in post-positivist thought, communication studies, and theater. Performance studies and critical performance ethnography "struggles to open the space between analysis and action, and to pull the pin on the binary opposition between theory and practice" (Conquergood, 2002, p. 145). With performance studies, all the world, all cultural production, is a stage. Policy, conversations, and bodies are all sites where exchanges can clue a critical eye into far more than the words spoken or actions taken (Conquergood, 1986; Hamera, 2013). On micro and macro levels, it is possible to see how social codes across and within cultures are expressed, ignored, and mediated for the purpose of analyzing power and creating change (Gonzalez, 2014). In international aid to education in Africa, I use performance studies to

highlight the practical knowledge gap that plagues the field. Often, employees at IAO will point to practical, proven solutions that exist in other contexts but are "impossible" to implement at IAO due to certain barriers. This willful rejection of appropriate technology, local expertise, and cost-effective solutions in favor of the status quo is a performance for both the individual and the institution—a performance that can be subconscious and encouraged even by people and organizations that would benefit from changed practices and policies.

In discussing social scripts and performances, critical performance studies adopt a construct of "co-performative witnessing" over that of critical dialogue analysis and the researcher/other dichotomy (Conquergood, 1985). Co-performative witnessing in performance studies is an attempt to account for the gaze, ethics, and the multilayered possibility and performance behind all speech to ultimately prevent a single interaction from becoming the only story of a person, people, or place (Hamera, 2013). With this understanding, my positionality is inseparable from scholarship regardless of whether I employ qualitative, quantitative, or mixed-methods. Likewise, IAO employees and programs are the results of combined actions and conversations layered over history and time. Performance studies additionally offers co-performative witnessing as a method for rejecting the academic "fetishization" of written work over oral and other forms (Johnson, 2013). A fetish for written work perpetuates Western hegemony and seeks to delegitimize and erase the vast amounts of knowledge and action that are unwritten (Conquergood, 2002). Written academic texts also attempt to re/create versions of history that are impossibly definite and single-authored.

Everything we do is a performance that is co-conducted by others, the environment, and our histories; our lives can be seen as a series of improvised moments where we "play,"

according to Smith (2016), based on a full range of possibilities. There is not one script for the powerful and one for the powerless; we can all become fluid in any performance language

> My experience as an educational ethnography, to date, can sometimes be described as traveling those blurred boundaries when Other becomes researcher, narrated becomes narrator, translated becomes translator, native becomes anthropologist, and how one emergent and intermittent identity continuously informs the other. (Madison, 2011, p. 8)

As a theoretical lens, performance studies dictate that researchers use their positionality and academic credentials as a tactic to undermine structures of power and advocate for others, a position that resonates with my personal goals of creating a more balanced aid economy (Conquergood, 2002; Johnson, 2013). Below, I discuss how individual and systemic performances of "powerful" or "powerless" in the aid economy work together to maintain an unjust system.

Powerful/Powerless—Institutions and Individuals

One dominant narrative in aid and development is that benevolent and powerful nations give money to poor, helpless countries (Moyo, 2009). This false dichotomy reinforces the idea that all nations that receive aid have nothing positive within their borders; under this idea, governments that receive assistance funding must lack in all respects (education, talent, power, and capacity). I use the theoretical framework of critical performance studies to dismantle this idea. There is hope, expertise, wisdom, abuse of power, injustice, and suffering in both the global north and the global south. The highs and lows of humanity are not geographically bound.

Performance studies understands MOEST and USAID as institutions operating within a historic power dynamic that is meticulously maintained by both parties. Within this system, some individuals will, at times, find themselves both powerfully capable of shaping a program, grant, or activity and a short time later their hands tied, unable to enter a conversation on a topic of their expertise. Below, I discuss these in terms of institutional and individual power dynamics.

On the institutional level, the system is designed to perpetuate itself. The role of the powerful IAO is made abundantly clear using symbols such as large vehicles, excessive security details, and highly salaried staff. The powerless are often in a position of accepting the "gifts" of the powerful—imposed aid terms, spending limits, conditions, and sanctions—because the aid economy is not designed to see worth in the people or systems of those who receive aid until they have been transformed by the grants and loans.

Individuals are also responsible for perpetuating the institutional narrative, but they do so in ways that allow them to be simultaneously powerful and powerless. Staff at recipient nation offices can sabotage IAO projects in powerful ways by withholding information, misdirecting counterparts, and ignoring communication. While this may reinforce the IAO assumption that the global south and its people lack value, it is at the same time a "powerful" response. Likewise, individual employees at IAO can choose not to participate in high-level conversations in their offices or political discussions in their home countries; the idea of wiping one's hands of a situation is a powerful submission that allows the aid economy to maintain itself and its unbalanced nature in Africa.

IAO Generated & Sustained Power Dynamics

The process of school site selection is wrapped up in both institutional and individual power dynamics. For example, IAO officials working on the SEED grant were troubled by the high overall costs of school construction at $295,000 per school, while MOEST itself was spending less than $10,000 for each new school built. Officials at MOEST were unwilling to approve a more efficiently designed, low-cost school for IAO because they believed IAO, as a powerful aid organization, should be spending more. This research does not seek to disrupt the

critical performance of aid and development in Africa but to offer a new script in which IAO and recipient nations can envision themselves.

Last summer, I privately asked a Malawian employed by IAO for his opinion on the Fall Armyworm outbreak, a foreign parasite that had somehow found its way to Malawi and was devastating thousands of acres of staple crops in a famine-prone country. He refused to speak on the subject, perhaps unwilling to have any negative comments about his employer attached to his name—ever aware of the power balance, even in our private conversation. I recognized his fear, understood it in context. I have, on occasion, had this same feeling and have found myself in a similar position, but this time, I did not feel the need to share it.

Americans export more food aid than any other country in the world—American farmers have their crops subsidized, and the surplus is transported globally as aid. This dangerous cycle, while upholding the flailing agricultural industry in the US, can devastate regional and local markets abroad. At IAO, I accepted my Malawian coworker's silence, but I openly questioned other officers and staff members—even as an intern, I had the right and privilege to do just that. Fall Army Worm has now been exported throughout Africa and Asia and is destroying crops at alarming rates. Pesticide resistant seeds have been developed and distributed to American farmers, but in Malawi, where Monsanto will reap lower profits, farmers are being encouraged to "plant tall grasses" to lure the pests away (Prasanna, Huesing, & Eddy, 2018). How Government of Malawi officials address this plague and what will constitute an appropriate response by American officials will be dictated by critical performance—it is possible to study these responses and change what "normal" roles are for these individuals and in turn, change the way aid in Africa operates.

The performance of power in the aid economy can allow good intentions to cover dangerous and devastating consequences. IAOs and recipient nations must work as both individuals and institutions to change the performance and production of aid. In the next section, I discuss my rationale for using a mixed-methods design and review the foundations of mixed-methods case study and mixed methods GIS.

Methodology

Introduction

The discovery of extremely high rates of HIV/AIDs infections along truck routes in Africa in the late 1990's sparked a flood of research in southern and eastern Africa. Malawi, as an officially English-speaking country and newly democratic nation, was primed to become a hub for Western researchers (Kaler & Watkins, 2010). Studies on HIV infection, prevention, and intervention initially utilized quantitative methods, but these proved to be far less effective than the qualitative inquiry that came in later years (Schatz, Angotti, Madhavan, & Sennott, 2015). The present need for "culturally sensitive instruments" that "amass essential local terminology" to prevent the "bias of 'outsider' researchers" is needed throughout the Global South (Schatz et al., 2015). Because much of the Global South, has historically been unexamined through a critical lens, mixed-methods studies that "study-up" and question powerful institutions and policymakers are of the utmost importance (Lillis, 2008; Noblit, Flores, & Murillo, 2004). "Studying up" can include examinations of development work done in partnership with counterparts in recipient nation governments and research that challenges existing practices and policies at IAOs (Englund, 2006).

To create lasting change for underserved communities, mixed methods research on international aid to education will be required. Rather than reinforce unnecessary methodological

divisions, combining qualitative and quantitative data can lead to powerful insights. Mixed methods research allows for the full exploration of *how* a phenomenon happens and the circumstances surrounding it. This type of research is urgently needed in analyzing the work of international aid organizations to education in Malawi (Marshall & Rossman, 2011).

Mixed methods research in emerging fields, such as international aid to education, can offer actionable insight as to how aid is distributed and what processes drive decision-making. Mixed methods research and enacting policy that builds on its recommendations will be crucial in increasing principles of ownership in aid to education. In this section, I outline how this research incorporates elements of educational mixed methods research, case study mixed methods, and qualitative GIS, to provide insight on processes and procedures at IAO.

Mixed Methods Rationale

Mixed methods research (MMR) allows researchers to ask "problems that normally emerge at the end of a project to be addressed before closure" (Morse, 2017, p. 2). To achieve this, MMR is based on two components, a core project and a supplementary project. The core component would be incomprehensible or unpublishable apart from its complementary research component, which gives access to parts of the research the core component does not (Morse, 2017). The qualitative data and analysis support the quantitative data and analysis and vice versa. Thus, mixed-methods research is defined as:

> An approach to research in the social, behavioral, and health sciences in which the investigator gathers both quantitative (close-ended) and qualitative (open-ended) data, integrates the two, and then draw interpretations based on the combined strengths of both sets of data to understand research problems." (Creswell, 2015, p. 2)

This research is a mixed methods case study with a convergent core design involving two cases. The first case involves the qualitative and quantitative data associated with manually generating a list of potential sites for new school construction in Malawi. The second case uses

GIS technology to create a list of potential sites for new school construction. In the next sections, I describe mixed methods case study as well as mixed methods GIS; these methodologies are complementary and I combine components of all three to complete this research.

Mixed Methods Case Study

Creswell and Clark (2018) identify three major types of mixed methods: convergent parallel design, explanatory sequential design, and exploratory sequential design. Additionally, Creswell and Clark (2018) identify four prominent types of complex mixed methods design; experimental/intervention, case study, participatory-social justice, and evaluation design. This research uses a convergent core case study design, which I discuss at length below.

Creswell and Clark (2018) have stated the case for conducting mixed-methods research. These types of studies are recommended when a description or analysis of multiple cases is needed using both quantitative and qualitative data. They require researchers to have the necessary knowledge and expertise in quantitative and qualitative data analysis, interest in comparing cases, access to data, and links to a discipline that values qualitative research. The philosophical assumptions of case study design are that the research will culminate in a description of one or more cases, and the process will inform the selection of cases, data choice, description, and integration (Creswell & Clark, 2018). Procedures for case study are to collect and analyze both qualitative and quantitative data, merge and analyze the data, and interpret each case. This methodology can lead to an in-depth understanding of cases, the ability to compare along quantitative and qualitative dimensions, and practical solutions for complex systems. Challenges most associated with case study methodologies are researchers without the necessary expertise, identifying the correct number and delineation of cases, and difficulties sharing case

descriptions in detail (Creswell & Clark, 2018). I discuss concerns in more detail in the section on limitations.

In alignment with Clark & Badiee's (2010) framework for identifying mixed methods research questions, I have developed questions suggested by actual problems I found at IAO; my questions are influenced by communities of practice in aid and international education; and my questions fit my personal beliefs and experiences. Comparing my experiences selecting new school construction sites manually with the process of using GIS to identify potential sites can provide relevant insight as to how and when IAOs can use GIS as a tool for new site selection.

In accordance with existing mixed-methods practices, I concurrently collected qualitative and quantitative data before merging and analyzing the data using a side-by-side comparison method. This process resulted in two cases for discussion: Case #1, manual sites, and Case #2, GIS-generated sites. In the results section, the two cases are compared and cross-analyzed for an in-depth understanding of which method is best suited for IAO operations in Africa. Before providing more detail on my methodology, I use the next section to explore in depth the use of mixed methods as a supplementary approach for Case #2.

Mixed Methods GIS

Mixed methods GIS is a new field, and researchers use the terms mixed-methods GIS, qualitative GIS, and critical GIS interchangeably in reference to spatial methodologies and analytical techniques that push beyond the desire to be objective (Cope & Elwood, 2009). In this paper I primarily use MMGIS to refer to this collective movement; where individual researchers have specified the use of qualitative or critical GIS, I adopt their desired terminology.

Due to the technical nature of GIS software, the related research is often viewed as distinctly positivist, quantitative, and numerically based (Kwan & Knigge, 2006). Yet, since the

inception of GIS as a field, scholars have utilized mixed methods approaches (Pavlovskaya, 2009; Yoon & Libineski, 2017). Qualitative GIS and Mixed Methods Geographical Information Systems (MMGIS) has "a unique philosophical and epistemological orientation…It combines quantitative and qualitative approaches to understand complex social and educational phenomena that cannot be understood fully if they are examined using separate approaches" (Yoon & Libineski, 2018, p. 55). In the following sections, I outline the origins of new GIS methods as well as the connections of MMGIS to educational research before offering a detailed review of the case study design used in this research, informed by both qualitative GIS and educational MMGIS.

Qualitative GIS (QGIS)

The first and only full-length book on Qualitative and Mixed Methods GIS by Cope and Elwood (2009) outlines the fields origins, methodological considerations, and practical implications for researchers interested in shifting GIS research by treating knowledge as ever-partial, inherently situated, and never separate from the decisions researchers make as they gather, analyze, interpret, and represent information (Kemper, 2014). Qualitative GIS, Critical GIS, MMGIS, and non-quantitative GIS all stem from a frustration with GIS research rooted only in quantitative analysis that purports to be an objective separation of the researcher from the product; in this research I refer to these traditions collectively and interchangeably as MMGIS and critical GIS (Schuurman, 2000; Wilson, 2009; Cope & Elwood, 2009).

For researchers, MMGIS means a commitment to recognizing GIS as a negotiated power relation in knowledge production, instead of a singular, constant mapping (Pavlovskaya, 2009). Thus, MMGIS cannot exclusively be considered as an addition of qualitative research to quantitative questions but must also include qualitative modes of analysis to traditionally

quantitative research practices. Knowledge-making is an inherently political process and qualitative GIS considers the critical reflexivity required by researchers to question power relations, dominant forms of knowledge, and research design as the incorporation of vital qualitative data in MMGIS (Cope & Elwood, 2009).

Broadly, MMGIS encapsulates GIS representations, analytical interventions, and conceptual engagements "as inseparable from the performative, representational, or analytical practices through which these meanings are produced" and occurring explicitly and implicitly in data structure, spatial analysis, maps, and the use of GIS tools in sociopolitical practices (Cope & Elwood, 2009, pg. 6). Of these three, this research uses qualitative conceptual engagement in the analysis of IAO school construction in Malawi. Below, I briefly discuss insider/outsider positionality of MMGIS researchers and techno-positionality to frame the qualitative portion of this mixed methods case study.

Insider/Outsider in MMGIS. Shuurman's (2000) definitive work on critical GIS cautioned researchers from distancing themselves from the technological infrastructure of GIS less their critiques become so distanced from the vocabulary of the technology that they are immediately deemed irrelevant. This warning is equally applicable to research that seeks to influence international aid to education; positioning oneself as a non-member of any field can cause a valid critique to be received as "trashing", "distant", and "destructive" despite the same insight from an insider that is not based in social theory-based critique being received as "caring," "legitimate," and "constructive (Wilson, 2009). Wilson (2009) notes that the researcher requires a techno-positionality in striking this balance as "inbetween" and "borderlands" in efforts to affect change while maintaining relevance and invoking qualitative insights about the "fixed" nature of geographical and spatial representations.

Techno-Positionality in MMGIS. Techno-positionality is the position of the "conflicted insider privy to the terminologies of the technology, and yet uninterested in the continuities of the technology." (Wilson, 2009, p.8) For MMGIS on aid to education, techno-positionality represents a researcher's commitment to producing work that resonates within a field while actively recharacterizing the field's dominant narrative. For this work, techno-positionality is a call to re-think ways of knowing through mixing methods and analysis that are in-between GIS, global capitalism, and the bounds of academic disciplines (Wilson, 2009).

In analyzing practices and processes in international aid to education this research utilizes qualitative traditions in MMGIS that include disrupting hegemonic practices through storytelling and "muddying the boundaries [of] the mixing of methods" (Wilson, 2009)

Education and MMGIS.

In education, MMGIS does not assume researchers as neutral; instead, it reflects on what types of assumptions and unexamined ways of thinking researchers bring to educational context (Yoon, Gulson, & Libineski, 2018). GIS can be beneficial to communities wishing to tackle large-scale issues such as poverty because they require an integrated approach and offer the option to consult multiple large-scale data sets (Dunn, Atkins, & Townsend, 1997). GIS is appropriate technology, when compared to other aid tools, for contextualizing locations and highlighting areas for opportunity in aid to education for historically marginalized communities (Dunn, Atkins, & Townsend, 1997).

The ease with which disconnects can occur between quantitative and qualitative data is seen clearly in the comment of several GIS researchers with the Opportunity Atlas tour in Charlotte, NC, who had the chance to compare what they saw in person to the data they have been manipulating in labs for years:

> The homes [around West Charlotte High] are neat, one-story single families, a tad rough around the edges but nothing like the burnt-out buildings in Detroit, where Williams previously worked... "It reminds you how hard it is to tell where real opportunity is…you can't just see it." (Cook, 2019, p. 14).

Cook (2019) offers a cautionary tale to MMGIS practitioners; there is a picture of poverty and destitution that each researcher brings to the table, and this instinctive definition must continuously be questioned. Many of the influencing factors in education are "invisible" factors such as test scores, parental income, and reading level, none of which can be seen on students. For this reason, researchers must take care to map test scores alongside information on communities and families.

MMGIS embraces multiple ways and sources of knowing while promoting pragmatism as the greatest philosophical tradition for answering research questions in a complex world (Yoon & Libineski, 2017; Creswell & Clark, 2007). Historically, GIS use in education and other humanities has suffered because of researchers' inability to rework GIS beyond military and corporate contexts; develop a technological imagination that is paired with resources; cross the qualitative-quantitative divide; employ critical GIS methods and theory; and center social justice (Gieseking, 2018). The difficulties for MMGIS researchers are not limited to their personal and disciplinary biases.

GIS can be a powerful tool for selecting new sites for school construction. The task of manually identifying potential sites is not simple, but MMGIS can work to address some of these complexities. For both manual and GIS methods, the task of selecting sites for school construction is a multi-layered process due to the large number of possible locations, contradicting objectives and requirements from communities and school officials, intangible and unquantifiable objectives around what makes a site "good" for a schools diversity of

stakeholders, uncertainty of construction impact on the broader community; and validity of decision-making (Eldrandaly, 2013).

The difficulty of this task is amplified when using quantitative data alone. Decontextualized quantitative data is time-consuming to process, provides little to no transparency, and puts planners in the dark as they often have no background on potential sites and communities (Bukhari, Rodzi, & Noordin, 2010). From my own experience, quantitative data provided by MOEST can be limited to test scores and attendance rates, and there is little opportunity for discussing irregularities in the data. Quantitative data alone provides no context on how many schools are located within a similar zone, how long a school has been open, or how many qualified teachers are employed. Mixed Methods GIS allows researchers to couple quantitative and qualitative datasets for more significant insights.

Thus far, I have discussed the practical origins of my research questions and how performance studies provides a useful theoretical framework in examining those questions. I then outlined the ways in which new GIS methodologies and case study combined are well suited methodologies for understanding the process of new school site selection in international aid on both quantitative and qualitative measures. In the next section, I discuss the design and potential limitations of this research.

Mixed Methods Case Study Design

The intent of this convergent mixed methods case study is to explore best practices for IAOs in selecting sites for new school construction in the future. The procedures and methodology presented below build on the work of previous scholars in case study methodology, GIS in education, and comparing GIS and manual methods (Tate, 2008; Hogrebe & Tate, 2019; Barzani & Bin Osman Salleh, 2015; Bukhari, Rodzi, & Noordin, 2010; Samad, Hifni, Ghazali,

Hashim, Disa, & Mahmud, 2012; HaryPrasetyo, Muhamad, & Fauzi, 2016; Harris, Hopkinson, McCaffrey, & Huntsinger, 1997; Burhanuddin, 1993).

In the study, school and student data and geographical maps (shapefiles) will be used to generate a list of school communities in Malawi capable of accommodating and fully enrolling a new secondary school. I assess this question using a comparative analysis of two distinct cases—the process of using GIS analytical methods for site selection compared to manual analytic methods. In this convergent design, qualitative and quantitative data are both collected and then merged for results. The reason for combining quantitative and qualitative data is to better incorporate the qualitative process of manual versus GIS methods alongside the quantitative results of where to build schools. The case analysis of both the process and the results will yield conclusions that more realistically respond to process integration at IAOs and support future policy recommendations.

Outline of the Study

In this section, I outline the step-by-step process for comparing the use of manual and GIS-generated results as site selection tools for IAOs. The diagram below offers a visual on how this mixed methods case study was executed.

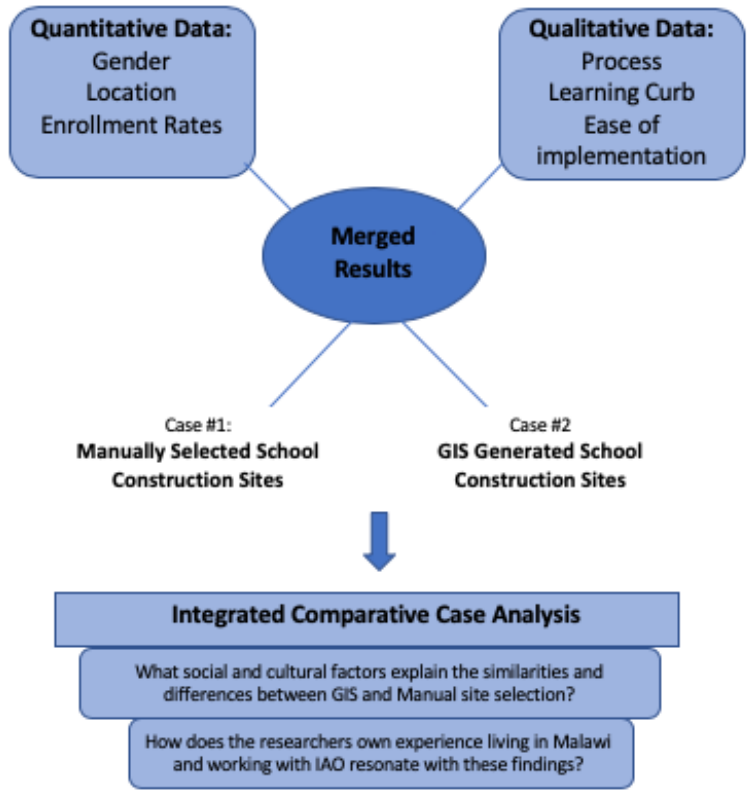


Figure 4. Diagram of study.
Adapted from "Designing and Conducting Mixed Methods Research" by Creswell & Clark, 2018.

Step 1. Intelligence and Information Gathering Phase

- Understand aid systems and identify processes and procedures within IAO and MOEST
- Determine parameters for selecting sites for new school construction under SEED grant

Step 2. Design Quantitative Processing Methods

- Manual Case Study
  - Use school attendance rates, test-pass rates aggregated by gender, and current capacity to determine optimal sites for new school construction
  - Chart results on printed maps

        - Finalize list of optimal sites for new school construction for education district
        - Complete analysis for each district of Malawi
    - GIS Case Study
        - Design process for using school attendance rates, test pass rates aggregated by gender, and current capacity to determine optimal sites for new school construction
        - Import results into electronic maps
        - Finalize list of optimal sites for new school construction for education district
        - Complete analysis for each district of Malawi

Step 3. Design Qualitative Processing Methods

- Manual Case Study
    - Record researcher's experience reviewing and selecting sites including duration of activity, ease of implementation, and actual and/or potential for interaction with MOEST
- GIS Case Study
    - Record researcher's experience reviewing and selecting sites including duration of activity, ease of implementation, and actual and/or potential for interaction with MOEST.

Step 4. Merge Results.

- Summarize and interpret quantitative results for manual and GIS cases; identify differences and select three examples of variance to discuss at length.

- Summarize author's qualitative experience with GIS methods versus manual methods.

Step 5. Comparative Case Analysis

- Compare results for both cases using side-by-side comparison discussion of quantitative and qualitative results
- Determine recommendations for IAOs based on both qualitative and quantitative comparisons.

Researchers Role, Trust, & Ethics

Using Marshall and Rossman's (2011) recommendations for designing qualitative research to guide ethical considerations on participants, sampling, access, and researcher's role, I review these in detail below.

Research Site and Participants. This study uses my own reflections interpreting and analyzing data; as such, an IRB exemption was approved in November 2019 (Appendix B). Data analysis will be completed in Chapel Hill, North Carolina. While my work is situated in activist traditions of finding solutions for policy in Malawi, good intentions alone are not enough to justify work in the aid economy or global south (Englund, 2006). While I am not Malawian and my life experiences vary greatly from those at the schools I study, I consider Merrick's (1999) article as fair warning that I must fight against any notion that the Malawian context is so far removed from my own that I will struggle to understand their basic needs as parallel or related to my own. This research is also guided by the reflections of African-American scholars working with a critical race lens as they navigate the blurry line between personal narratives, activist desires, and research standards (Carter, 2002).

Site Selection and Sampling. The data will be assessed for each of the 32 educational administrative districts in Malawi. This is a universal population and no sampling techniques will be required (Ware, Ferron, & Miller, 2013). While the remote use of GIS data analysis does not require reciprocity considerations, outside the usefulness of the research in advocating for change, there are ethical considerations for this type of research. Five primary concerns are privacy, topic sensitivity, degree of researcher interaction, subject vulnerability, and ethics (Marshall & Rossman, 2011). The identity of the communities and school pass rates are in the public domain and in some ways ambiguous because of the sheer size of the data. Still, published information will not go beyond the school level. For the sake of creating actionable policy recommendations, community names will not be assigned pseudonyms (Gieseking, 2018; Marshall & Rossman, 2011).

Entry and Access. All information, including shapefiles, are publicly available using the Malawi Spatial Data Portal (MASDAP), StatSilk, and Afrobarometer sites. This information is published through funding from the World Bank and UNESCO in order to support GIS research in Africa. The research topic itself is urgent but not sensitive and further considerations for identity protection are not needed at this time. I will only interact with static datasets and my own experience; thus, no protection needs to be given for navigating this interaction. Subjects are not vulnerable as they relate to the research, ergo additional consent would be unnecessary; it would also be virtually impossible to obtain. Because of the potential for the research to be immediately applied in the field, it is urgent and necessary work and possible subject to "outside bias". The use of publicly available data can navigate some of this potential bias, because I was not present to influence the data collection in any intentional or subliminal way (Markham, 2004).

Case #1. Manual Method

In 2016, I, in collaboration with MOEST and IAO, developed a manual system for analyzing student attendance and test score data, charting this information onto physical maps, and determining recommended sites for new school construction. In this section, I outline the study setting, sampling method, school differences, data considerations, and manual process and procedures.

Study Setting

When the research began, the IAO/Education office was located in Lilongwe, Malawi, with a team of seven full-time employees, six Malawian nationals and one American. I joined this team as an intern charged with mapping potential sites for new school construction—all other employees being engaged in other activities but were able to offer limited guidance and advice. Initially, I partnered with a Malawian consultant, who previously gathered the datasets, drafted a report template, and shared initial methodology. The process of site selection was expected to be completed in three months, with progress reported to MOEST in person and via electronic communication as it was made. I was expected to work alone and submit completed district reports to the office supervisor who would review, provide comments, and share with MOEST.

The IAO/Education office portfolio in Malawi has historically focused on primary school reading initiatives and related activities—at the time, there was little activity in the secondary or tertiary institutions. In line with previous IAO initiatives, IAO/Education wished to build new schools in rural areas (greater than 10km from a main road and away from existing secondary schools), where male and female pass rates exceeded 50 students, and overall pass rates were

greater than 75%. When needed, these initial criteria were revised and altered, depending on district realities, as discussed at length below.

Sampling Strategy, Data, and Variables

SEED was designed to construct or expand schools in every district of Malawi, with the exception of Likoma Island. The Likoma Island District was not included in the grant due to high transportation costs and existing under-enrollment in secondary schools.

In order to understand the site selection process, I provide a brief outline of the administrative infrastructure for education in Malawi.

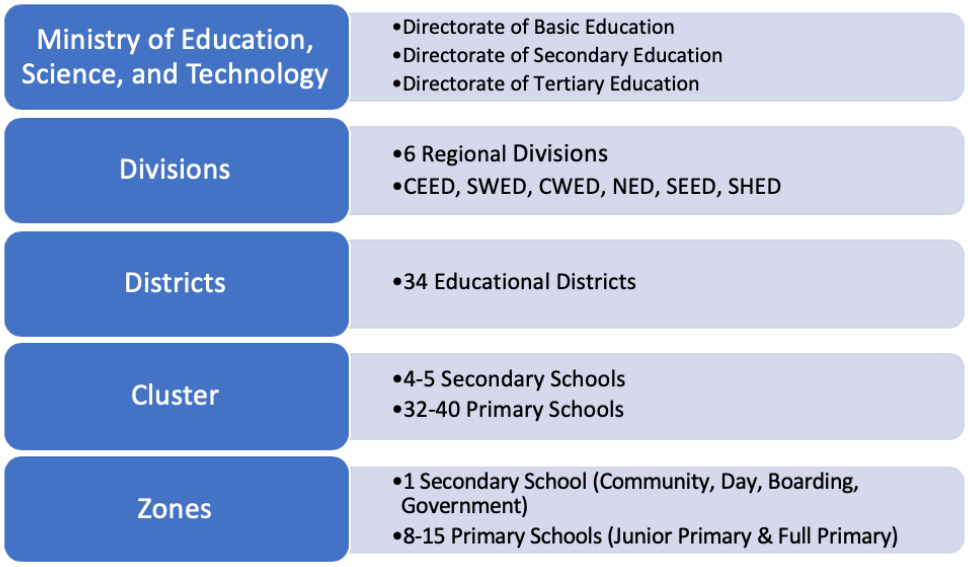


Figure 5. Hierarchy of educational administrative structure in Malawi

Administrative Structure of Education in Malawi. The Ministry of Education, Science, and Technology (MOEST) is the authority for policy, curriculum, and standards for all primary, secondary, and tertiary schools. Each level of schooling has a dedicated directorate that manages monitoring and evaluation; they also assist in coordinating aid from IAOs and private organizations (Asim, Chimombo, Chugunov, & Gera, 2019; Kafumbu, 2019). Management for

primary and secondary schools is divided into six regional divisions: Central East Education Division (CEED), South West Education Division (SWED), Central West Education Division (CWED), North Education Division (NED), South East Education Division (SEED), and Shire Highlands Education Division (SHED). Each education division contains five to six districts.

In Malawi, there are thirty-four administrative districts (see Figure 5). Other government agencies use twenty-eight administrative districts, however. Due to enrollments in urban areas, large city districts are split into multiple units for education administration; e.g., Lilongwe becomes Lilongwe Urban, Lilongwe Rural East, and Lilongwe Rural West. Each district is further divided into zones containing eight to fifteen primary schools that feed into a single secondary school. Administrative staff, including District Education Managers (DEMs), Primary Education Advisors (PEAs), and Teacher Development Centers (TDCs), are located at every level of the administrative structure.

School Types. Malawian primary and secondary schools can be owned and operated by the government, a religious organization, or a private company or individual. The SEED grant focused primarily on government schools, but there is often a blurred line between religious schools and government schools; in some instances, religious organizations will construct a building on government property or renovate a closed school that was previously owned by the government. Additionally, it is not uncommon for operations to move from a private company to the government or to a religious organization. These changes have not always been tracked at the national level, and determining ownership of a school is, at times, necessary to research on a case by case basis.

Standards (Standard 1-8, primary school) and forms (Forms 1-4, secondary school) are the equivalent of US grade levels in elementary/middle and high school, respectively. Primary

schools can be full or junior schools; full primary schools have students in standards one through eight while junior primary schools only enroll students in standards one through five, and as such, are not included in the SEED grant.

Secondary schools enroll students in Form 1-4. There are several categories of public secondary schools in Malawi, community day secondary schools (CDSS), government secondary schools, national secondary schools, conventional secondary schools, and open day secondary schools.

CDSSs offer the lowest cost barriers to student participation and are located throughout Malawi, enrolling the highest portion of students; CDSSs are also known for low-quality instruction, high rates of male pupils, and dismal performance on national exams (Zeitlyn, Lewin, Chimombo, & Meke, 2015). National government secondary schools receive more support from MOEST compared to CDSSs and are located in urban and peri-urban centers. National secondary schools and conventional secondary schools often have boarding options and include some gender-specific (boys only or girls only) schools. These institutions have the highest rates of performance on national exams and have correspondingly low admission rates.

Open day secondary schools (ODSS) are known as “shift schools” and often operate in CDSS buildings. ODSSs use the same government-issue teachers, curriculum, and textbooks but enroll students who were not selected by the government to attend CDSS classes; the student population at ODSSs is disproportionately male and includes high rates of grade repeaters and out-of-school youth (Kamwendo, 2010).

In site visits and communication with MOEST officials, it was noted that the official capacity of schools rarely reflects actual attendance. The existing secondary school infrastructure, coupled with high need in a nation where sixty percent of the population is under

the age of twenty-five years, means that spaces are used until their maximum capacity is exceeded. Schools designated for fifty pupils often enrolled more than 500 in multiple shifts throughout the day.

Data. Data for this analysis was provided by MOEST to IAO using a portable hard drive. These data included:

- "Public Schools Primary School Leaving Certificate Examination and Enrollment for 2016" (Appendix C)—includes Excel data for 5,471 public primary schools on the number of students who "sat" for the PSLCE exam as well as pass rates, disaggregated by gender. This information was listed by division, district, zone, and school name.
- "Public Secondary Schools Enrolment by Form" (Appendix D)—includes Excel data for 2016 secondary enrolment at 1,039 public schools for Forms 1-4 disaggregated by gender. This information was listed by division, district, cluster, and school.
- "Feeder Schools for all Secondary Schools" (Appendix E)—includes Excel data on the designated capacity for all secondary schools, as well as which set of primary schools, feeds into which secondary schools. This data was provided by division and then district.

Data from these separate Excel sheets were manually combined using Excel based on methodology discussed at length in the procedures section.

Data Collection, Processing, and Validation. Annually, MOEST conducts a national school census using EMIS information, which is analyzed and shared publicly in the yearly "EMIS Final Report" published by MOEST (2016). IAO obtained the 2016 raw data, which was

collected at the zonal and district levels for all 34 education districts. Educational administrative staff, PEAs, and DEMs work with headteachers and district officers to ensure that surveys are filled and submitted within the allotted 24-day time period. The school-level data were submitted to zonal and district supervisors who electronically submitted to EMIS using ED* Assist (Education Automated Statistical tool kit), a software package that eases data collection and merging by automatically tracking schools from the main registry on local networks. Data validation checks are then made by district and zonal administrators as well as the national EMIS database.

This analysis does not include data for Likoma Island. Additionally, several components of the SEED grant were already underway when the site selection began including:

- Construction of 16 CDSS in Balaka, Machinga, and Mzimba North and 1 girls' dormitory in Mzimba North in partnership with AMAA/Give Girls a Chance to Learn Project;
- Construction of 1 CDSS each in partnership with the USDA and the World Food Programme (WFP) in the districts of Dedza, Nsanje, Mulanje, Thoylo, and Chiradzula.
- Expansion of 33 existing CDSSs in Blantyre, Zomba, Lilongwe, and Mzuzu.

These ongoing projects and unrelated shifts in funding sources complicated the site selection process and, at times, required new sites to be selected after the initial analysis.

Data Concerns. In addition to previously discussed complications with statistical data in southern Africa, I identified five major areas of concern associated with the data transmitted from MOEST; spelling inconsistencies, class size reductions, missing scores, impossible data

and missing schools. When I was unable to mediate these concerns, the schools were removed from the analysis.

The Chichewa language features several close consonant sounds that are not the same in English. I composed a list of high-frequency consonant swaps that would result in a school showing "no scores" when, in fact, a spelling discrepancy was to blame. These include "L"/"R", "M"/"N", and "B"/"V". It is possible for multiple swaps to occur in a single school name; for example, "Chimbilanjala Primary" become "Chimbiramjara Primary." It should also be noted that, commonly, these consonants or their pair could be altogether omitted from the official spelling.

Another concern in the data was the dramatic decrease in official class sizes as students progressed from Standard 7 to Standard 8. IAO/Education noted this concern in conversation with MOEST, and it was determined that schools and teachers could be deliberately underreporting attendance on EMIS surveys or preventing students unlikely to pass the PSLCE from advancing to Standard 8.

Additionally, some schools had missing data that was either not reported or partially reported. In some cases, I had difficulty determining whether missing data was due to gender-specific schools or errors in reporting. Also, I noted several cases of impossible data where, for example, the number of students listed as "passing" exceeded the number of students who took the exam.

Finally, in some cases, a school would appear on the official testing list as a public primary school but could not be located on school maps or in GPS databases. In instances where a school could not be located, or any of the above discrepancies could not be resolved, the school was omitted from consideration for new construction.

Manual Procedures

Overview. The process of identifying sites for new school construction began with combining Excel data from multiple sources into a single Excel sheet for each district. IAO computers were not equipped with SPSS, SAS, or STATA. IAO procedures for allotting the budget to purchase and install these software packages would have required approval from IAO local, national, regional, continental, and global headquarters and would have taken a substantial amount of time along with justification as to why software costs had not initially been considered. For security purposes, all freeware programs, including the statistical analysis software R, are prohibited on IAO computers. As a result, Microsoft Excel 2016 was the primary method for compiling and analyzing data. Reporting was completed using Microsoft Word 2016.

The per district aggregated data, "district identified sites," was used to identify which secondary schools were in greatest need of additional capacity within their zones. "District identified sites" for each district contained every public secondary school, secondary school capacity, feeder primary schools, primary school PSLCE exam sat and pass rates, and secondary school catering rates (Appendix E). "Sat" rates refer to the number of students from a given primary school that were admitted to the PSLCE exam. "Catering rate" refers to the percentage of passing students from a given group of feeder primary schools that the secondary school has the capacity to admit. The sheet was used to identify the secondary schools with the lowest catering rates, excluding national government, national secondary, and all boarding schools. The schools with the lowest catering rates were given priority status when considering sites for new construction. For each district, primary schools were manually located and marked with the total number of students who passed the PSLCE and the PSLCE pass rate (Appendix F). I was able to visually locate areas of need, their distance from main roadways, and their current distance to

existing secondary schools to identify potential sites for new construction. Selected sites were noted as "primary" choices and "secondary" or alternate choices. The primary and alternate sites were reported to MOEST per district along with a printed map of the location of each selected site (Appendices G, H, I).

Step-by-Step Procedures. Below, the manual process for site selection is described in greater detail.

1. For each district, I prepared an Excel spreadsheet that included each CDSS and its current capacity, the primary schools that feed to each CDSS, the number of males/females that took the PSCLE at each feeder school, and the male/female pass rate.
    a. The percentage of students catered to by the existing CDSS had to be calculated. The catering rate is a function of the total current intake for a CDSS divided by the total PSCLE pass rate for all of its primary feeder schools.
2. I used the "Feeder Schools for all Secondary Schools" Excel sheet to determine which primary schools are feeders for each secondary school in every district
    a. For some districts, a single primary school will feed into several secondary schools
    b. Not all feeder schools provided were full primary schools, some were junior primary (JP).
    c. Some schools labeled "JP" were full primary schools due to the recent addition of Standards 6-8. For this reason, each school had to be manually checked for PSLCE pass rates
3. I used the "Public Schools PSLCE & Enrolment" Excel sheet to find sat/pass rates for primary schools in each district.

a. Schools that had 0 students who sat and 0 student pass rates were previously JP and had test scores from that time that could be requested.
b. I had to be aware of common letter exchanges and substitutions and make a note in the remarks column, e.g.: Chimbilanjala = Chimbiramjala—potential exchanges of l/r, m/n, omitted b or v.
c. I had to note of any non-junior primary or private schools without PSLCE results.
d. I had to note of schools with pass rates higher than the number of students who sat.

4. For each district, I made note of the secondary schools with the lowest catering rates for students who passed the PSLCE. I did not include district day secondary schools or secondary schools that catered to all primary schools in this ranking.
5. For the five CDSSs with the lowest catering rate, I highlighted their feeder primary schools with the highest pass rate and second-highest pass rate.
    a. As I highlighted school pass rates, I made note of the current number of students who had passed, noting whether the school had produced 25 males and 25 females who had passed the PSCLE?
    b. I had to be aware of schools with high enrollment and lower pass rates. If 200 students were enrolled and 125 passed, the rate may have appeared low at 62.5%, but in terms of raw numbers, the school was producing more passing students than its neighbor with an 80% pass rate that had 12 students passing out of 15 total enrolled.
6. Using district maps, I located the two primary schools I had highlighted and marked them as potential new school construction sites.

a. Check the distance students would be required to walk to the existing CDSS—is it more than 10km each way?
b. Was the highest performing school located close to the existing CDSS? If the next highest performing primary school was located at a greater distance, I considered changing my selection to the next highest performing primary school.
c. If the highlighted primary site did not have 50 students to fill a potential CDSS, were there additional primary schools surrounding the selected site that could be drawn upon for additional students? I made a note of these "new zones" in the remarks section.

7. Using district maps, I located and highlighted all secondary schools.
    a. Were there gaps in locations where students were walking more than 10km each way?
    b. Were there clusters of schools in an isolated location that could fill a new CDSS?
8. Using the CDSS catering rates and infrastructure knowledge gaps on the maps, I selected five need zones and two potential sites per zone.
    a. These potential site selections were based on highest-performing feeder primary schools in areas with the lowest CDSS catering rate, the ability to produce at least 50 pupils passing the PSLCE, and at a substantial geographic distance from the existing CDSS.
9. I made approximately ten selections for potential sites per district, two each in five different zones, highlighting the top selection in red and the secondary or alternate selection in yellow.

Ultimately, 5,422 primary schools and 819 secondary schools were used in the manual case analysis. Of these, 152 primary schools were selected as "first choice" options for new school constructions and 146 primary schools were offered as "alternative" selections for new school construction. Despite differences in population sizes and the range of existing secondary schools in each district, between 4-6 first choice and 4-6 alternative selections were offered for each district. Descriptive data on the manual case study was computed using the Statistical Package for the Social Sciences (SPSS) for Windows version 26. Descriptive data, correlations, and regression analysis are presented in Chapter 5. In the next section, I outline procedures and context for Case #2.

Case #2. GIS Method

Study Setting

The GIS analysis took place in Chapel Hill, NC, USA, and was based on the dataset generated during SEED site analysis. The analysis for Case #2 took place on an American university campus and benefited greatly from collaborative research and university tools and resources. I drew upon four years of personal instruction in the dominant language of Malawi, Chichewa, that I received from Dr. Monda Mwaya and Helpstars Malawi, as well as relying upon the knowledge gained from auditing an introductory course on GIS in the Geography department. Additionally, I gained great insights from time with Dr. David Ansong (Assistant Professor in the Department of Social Work and GIS specialist), Philip McDaniel (Digital Research Services, GIS Librarian), Matthew Jansen (Data Analysis Librarian), and Cathy Zimmer (Odum Institute Social Science Researcher). While this research bears one name, it is the product of many others' input and insight.

Sampling Strategy, Data, and Variables

In order to most completely compare Case #1 and #2, the data sets share a number of the same variables and built on the same raw data collected by MOEST in 2016 including the division, district, secondary schools, secondary school capacity, feeder primary schools, and primary school PSLCE sat and pass rates. As such, a number of the concerns related to data collection, processing, and validation were similar to those listed for Case #1. Thus, this section outlines data concerns that existed in addition to those previously listed.

Data Collection. In addition to the data variables obtained during the data gathering stages for the manual case, the GIS case incorporated GIS shapefiles. Shapefiles are data files specific to ESRI's ArcGIS software, considered a leader in GIS data processing and analytics.

Environmental Systems Research Institute a globally leading provider of GIS software, was founded in California in 1969 as a land-use consulting company. ESRI's ArcGIS Pro software, released in 2016, is an attempt to offer a user-friendly interface for spatial analysis where key spatial analytical tools are easily accessed through drop-down menus and search tools instead of hidden behind several layers of menu options (MacDonald, 2018). Use of ArcGIS Pro software and ArcMap (also by ESRI) is not an endorsement of this product. However organizations seeking the least-resistant path to spatial analysis and reporting will likely use ESRI's licensed product over freeware such as QGIS due to the lower technical barriers to entry. As this research seeks to address solutions at IAOs, use of ESRI's software provides the most realistic option for practitioners.

The shapefiles obtained by IAO contain division and district boundaries, secondary schools with corresponding male and female enrollment for Forms 1-4, primary schools with the number of employed teachers, and student enrolment for Standards 1-8, all disaggregated by gender. Additionally, the shapefiles contained the EMIS numbers, X/Y coordinates, and

longitude and latitude information for each school. The shapefiles were generated by IAO to support book distribution, assessment, and evaluation of the National Reading Program in Malawi and were shared with me in 2018 from IAO.

Case #2 also utilized publicly available shapefiles from the Malawi Spatial Data Platform (MASDAP), a public platform administered by Malawi's Department of Surveys, National Spatial Data Center to assist development in Malawi. Additional geocoded data is from StatSilk, a World Bank-sponsored program that hots publicly available data for development and Afrobarometer, a Bill and Melinda Gates Foundation sponsored annual survey. Afrobarometer reports are publicly available, and the geocoded data can be obtained through a report request via electronically submitted form. Also, open-source shapefiles from geofrabrik.de and diva-gis.org were used to identify road networks and waterways in Malawi. Finally, Case #2 draws heavily on my personal experiences learning ArcGIS software.

Processing and Validation. Initial data cleaning was completed using Excel for Mac 2019. Each district-level analysis completed for Case #1 was consolidated and combined to create a national database for Case #2. The spreadsheet included all variables previously contained in Case #1 but was expanded to include EMIS registration numbers, X and Y coordinates for primary and secondary schools, longitude and latitude for primary schools, and district-level catering rates. The geographic coordinates (X and Y ; longitude and latitude) data was added using the "VLOOKUP" formula in Excel, which compared school names in a separate IAO document.

Additionally, the total capacity for secondary and primary schools, catering rates (male/female; primary/secondary), pass rates (male/female), and zonal capacity were generated, and cross-checked using Excel formulas. Of the 5,422 unique primary schools and 819

secondary schools imported from Case #1, forty-four records were deleted in order to remove the number of schools serving "all districts" from skewing capacity and catering averages. This process is discussed in detail in the procedures section.

Data Concerns. In addition to the concerns previously listed for Case #1 there are several concerns specific to Case #2. First, it should be noted that a large amount of manual work went into preparing the data, and the possibility of human error exists even in these largely software-dependent operations.

Second, my elementary knowledge of Chichewa was both a help and a hinderance. For instance, I was confident in matching Chichewa translations of English words for unpaired schools (e.g., Benjamin = Benjamini and St. Matthews = Saint Matias), but the choice of which school title was correct was based solely on my preference. Additionally, greater knowledge of Chichewa might have made additional pairings possible, "Ulema Kwa Atate" or "Respect for Our Father" primary school was translated via Google Translate, but might have been more easily noted by a native speaker or someone with greater fluency. While I have a basic understanding of standard prefixes in Chichewa (e.g., "pa," "ku," "mu," "ndi," "ma," etc.) the language structure is extremely complex and allows for sentence modification at the beginning, middle, and end of a sentence as well as combinations of multiple prefixes. A more experienced Chichewa speaker would have likely spotted the differences between a school "at the market" (Kumsika) or "of the market" (Yamsika) or "of spring" (Kumasika) with ease.

Third, the spelling of school names in the data sets so as to merge data correctly could be problematic. For some schools, commas were placed in between letters (Kang'oma), while in others, vowels were accented (Kangóma). In addition to commonly swapped letters (e.g., "l" for "r") there were often omitted letters and abbreviations. For districts with school names that

repeated it could be unclear which school matched with which EMIS; the school Chimvu was listed in the original dataset as "Chimvu," "Chimvu 1," and "Chimvu 2," but there were only two possible EMIS matches for these three data points within the same district.

Fourth, school titles were at times or omitted or abbreviated, such as junior primary (JP), full primary (FP), religious affiliations (Saint, Catholic, Church of Central Africa Presbyterian/CCAP) or government affiliation (Local Education Authority/LEA, demonstration/DEM, community day secondary). In cases of missing titles, close matches were made—for example, "Domasi" was matched as "Domasi Demonstration." In some instances, a school would have two unrelated names (Khanyizira/Zimbo or St. Dominic/Kholoni) or would be listed from a neighboring district; in these cases I used best judgement and geographic proximity, and all changes were noted and recorded in the national database.

Finally, I was solely responsible for all data combinations. In order to mitigate the risks of human error, I cross-checked data against EMIS shapefiles and IAO spreadsheets. Still, it would be ideal to submit the database to MOEST for official review before use in decision making.

Procedures

Overview. To create Case #2, I generated a national database from IAO and MOEST spreadsheets. The database was then cleaned and organized for division, district, zonal, and school-level analysis. Following initial preparation in Excel, the data was transferred to ArcGIS Pro 2.4.0, where a series of tools were used to analyze the data, including Moran's Index, Geographically Weighted Regression, and Getis-Ord Gi*. Moran's index allows researchers to identify geographic information as clustered, random, or dispersed through distribution analysis. Geographically weighted regression is an ordinary least squares, best-fit regression line that

utilizes geographic distance in a plane rather than two-dimensional distance. Getis-Ord Gi* is a calculation used to identify significant clusters of high and low values in order to identify hotspots. In the following sections, I discuss the step-by step process and statistical methods at length.

Data Preparation and Case Matching. Of the 5,422 primary schools in the national database, 1,980 were unable to match due to discrepancies in the national database versus the GPS spreadsheet. I manually paired 1,715 of these missing schools using knowledge of the language and geography of Malawi. Many cases were matched by substituting common letter pairings until a successful school match was found. Future research should include a step for cross-checking manual pairings with MOEST officials.

After manual cross-checking, 265 primary schools remained unmatched with GPS coordinates and were marked "no_gps" in the dataset. Of the 819 secondary schools, 75 schools did not match using VLOOKUP. These schools were then cross-checked against the GPS coordinates for common letter exchanges. Due to the relatively smaller number of secondary schools, unpaired instances were checked for a third time against the ArcGIS shapefiles, and ten additional locations were successfully identified.

Typically, software is used to calculate the "distance" between a range of words. The distance between "Chikala" and "Chikara" is one swapped letter and would be coded as a distance of one. A software package would then ask the researcher if the records should be changed to the same value. A "yes" input would allow the researcher to recode both cases as either "Chikala" or "Chikara." Due to the relatively small number of cases in this study, manual methods were advised, and I reviewed unpaired cases individually. The majority were matched

with distances of less than three. Some unpaired schools were found to be feeder schools from neighboring districts or were located by omitting common suffixes.

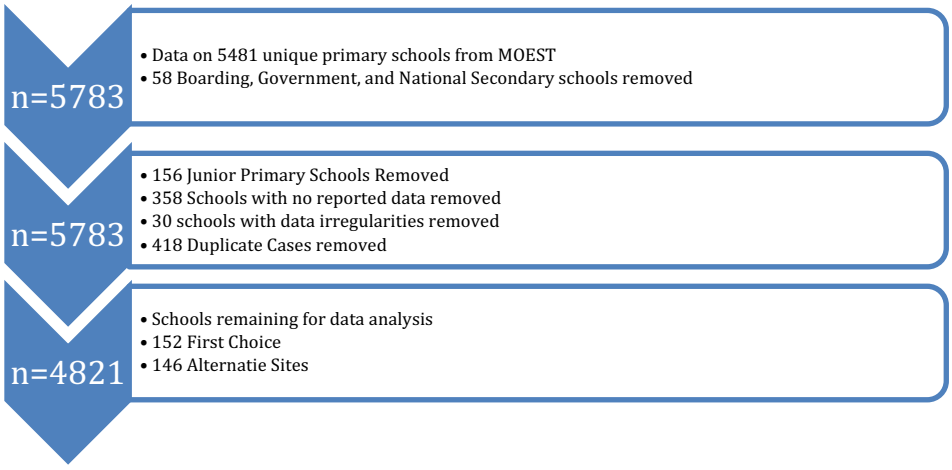


Figure 6. Participant flow

Fifty-eight secondary schools were identified as district-wide or boarding secondary schools and were removed from the data to prevent their disproportionately large enrollment pools from skewing the data. One hundred and fifty-six primary schools had no data across all PSLCE data and were noted as junior primary and removed from the data set to prevent their inclusion from skewing data. Additionally, 358 schools with no data that were non-participants or unmarked junior primary schools were removed. Thirty schools were found to have irregularities native to the data set, which recorded more students passing than sat for the PSLCE exam; these schools were removed from the dataset. 418 primary schools were cross-listed as feeder schools for multiple secondary schools; the duplicate listings of primary schools that send students to multiple secondary schools were removed. After the data had been cleaned, 4821 cases remained for analysis (Figure 6).

Using Excel formulas, I recalculated values for total enrolment capacity, total student sat rate, total student pass rate, catering rates (total and disaggregated by gender), and zonal capacity

and catering rate. The recalculation of values was done to eliminate any manual entry errors. After completion, spatial analysis using IAO-specified criteria was completed and it was determined that no schools fulfilled all of the parameters. In order to identify other areas of interest, additional analysis was completed using spatial analysis tools including Moran's index, geographically weighted regression, and hotspot analysis to identify areas for new site construction. These procedures are discussed at length in the next sections.

IAO Criteria Analysis. In order to create parallel cases and re-create the priorities of the IAO grant, I explored initial SEED criteria using spatial analysis tools. In order of priority, I set minimum criteria to locate sites that were:

1. > 10km from a main road
2. > 10km from an existing secondary school
3. n > 50 total students passing PSLCE
4. n > 25 girls passing PSLCE
5. > 75% PSLCE pass rate
6. Located in a zone with a low zonal catering rate

The ArcGIS buffer tool was used to create a 10km radius around existing secondary schools and major roads in Malawi. Countrywide there were fifty schools that existed outside of the geographic buffer zones. Of these fifty, three schools enrolled more than 50 students passing, and one school of these three schools enrolled more than twenty-five girls. This particular school did not fulfill the requirements for zonal catering rate or overall PSLCE pass rate.

Spatial Analysis with Moran's I. Moran's index is one of the most common cross-product statistical techniques used in geographic analysis (Chen, 2013; Fischer & Wang, 2011, Lee & Li, 2017). It was developed in the 1940's and uses a correlation matrix to determine if

values are normally or randomly distributed (Yamada & Okabe, 2015, Souris & Bichaud, 2011, Fischer & Wang, 2011). Moran's I begins with a null hypothesis that spatial pattern is random, and the data does not coordinate with itself. In ArcGis, Moran's I tool generates a z-score to assess whether data is clustered, dispersed, or random. If the z-score is statistically significant and the Moran's I value is positive then spatial clustering exists, while a negative value indicates dispersion. This research builds on Ansong's (2015, 2017) use of Moran's I to identify gender parity patterns in Ghanaian educational data.

Using a weights matrix, researchers in ArcGis can select the field they would like to calculate the statistic on (percent passing, catering rate, etc.) and then decide between an inverse distance or Euclidean distance method. This research uses an inverse distance method where nearby features have a larger impact on the target feature than more distant ones. In ArcGis, if Moran's index is positive and the p-value is zero, then clustering is strong and the null hypothesis has been rejected. The results are presented in a software-generated report where z-scores and p values can be read to determine significant clustering, non-significant clustering, and random dispersion. I present the results of Moran's I in Chapter 5.

Spatial Analysis with Getis-Ord Gi* Statistic. Getis-Ord Gi* is the statistical formula at the base of mathematical calculations for hotspot analysis. In GIS research it is used to identify significant clusters of high and low values (Ansong, Ansong, Ampomah, & Afranie, 2015; Ansong, Chowa, & Adabeng, 2015; Defar, Okwaraji, Tigabu, Persson, Alemu, 2019).

Complementing the Moran's I tool, Getis-Ord general analysis can validate the existence of spatial patterns and data clustering. Ansong (2017, 2015) uses both Moran's I and Getis-Ord Gi* tools to identify areas of statistically significant high and low gender parity values in Ghanaian educational data by exploring how neighboring districts might influence rates.

Getis-Ord Gi* asks of the data, “What are the chances that high and low scores are randomly grouped?” by identifying a neighborhood (zone of secondary school), within a study area (district) of the population (Malawi) (ESRI, 2011). In Arc-GIS, Getis-Ord Gi* returns results that identify a neighborhood as hot (higher than study area), cold (lower than the area), or not significant (random average of the area) at ninety, ninety-five, and ninety-nine percent confidence levels (Gwitira, Murwire, Zengeya, Shekede, 2018). Hotspot analysis is used to identify patterns in the data for causal inference. This research observed hotspots for the total number of students passing, girls pass rates, and zonal catering rates. The results are discussed at length in Chapter 5.

Spatial Analysis with Geographically Weighted Regression. Geographically weighted regression builds on the concepts of linear regression, line of best fit, and ordinary least squares. The ordinary least square is the line of best fit that minimizes the linear distance from each data point to the linear regression (Fischer & Wang, 2011). Instead of using linear distance to calculate the least squares line of best fit, geographically weighted regression uses spatial distance to identify statistically significant clusters of high and low values in GIS data (ESRI, 2011). Instead of identifying similar scores or cases, geographically weighted regression measures extreme homogeneity in spaces that are close in proximity (Ansong, Ampomah, Adjabeng, 2015).

Geographically weighted regression is a nonparametric, local regression based on a moving weighted average; the further away from a linear regression an item is, the less weight it is given in analysis, and all data points must add up to one. When using geographically weighted regression researchers must be selective about how wide the search area parameters are and the number of cases in a given area (Ansong, Renwick, Okumu, Ansong, Wabwire, 2018). This

research utilizes a large number of cases in predetermined districts and mitigates the risk of unintended bias when selected. I used geographically weighted regression to observe the impact of distance on girls' pass rates.

Kernel density analysis is a "sophisticated way to model the spread of services across a landscape, making it possible to assess whether [schools] are available to all populations (Ansong, 2014). A Kernel density analysis was observed on secondary schools to determine the availability of existing schools to serve the national population.

Identified Limitations and Challenges

Unintended Research Bias. Use of secondary data does not eliminate outsider bias in data analysis, and by personally selecting shapefiles and deciding when to include or exclude information, I could unintentionally influence the data. This possibility is something I am attempted to be aware of in my selection of data for inclusion and through continuous editing of the design (Silverman, 2013). Overall, the lack of analysis of the school site selection process in Malawi suggests a gap in the existing research that can be filled to improve the level of interaction between MOEST and development partners when selecting sites for construction. With the understanding that research on aid to education in Malawi can benefit from this type of data, the collection strategies and analysis are meant to allow for the least amount of instrumental bias.

GIS Military & Western Origins. "War is God's way of teaching Americans geography" (Bierce, quoted by Brock, 2013, p. 277). The primary market for GIS is the private sector in wealthy nations because the technology, while now cheaper than in previous decades, is cost-prohibitive to communities who cannot easily access equipment, software, training, and consistent electricity (Dunn, Atkins, & Townsend, 1997; Brock, 2013). For this reason, I

consider IAOs to be the hubs for the technology but clearly state that this work should be done in partnership with MOEST. In the global south, socioeconomic data is expensive to collect, subject to issues of power and ethics, and it can be unreliable (Dunn, Atkins, & Townsend, 1997). However, large IAOs have invested money, equipment, and infrastructure in collecting and publishing this data regularly. This study takes advantage of that information and uses it to guide future decision-making.

Over Interpretation. Maps can be treated as static "truths" because audiences rarely question who designed a map and for what purpose or motivation; as such, maps can be over-interpreted as well-intentioned and fairly sourced (Yoon & Libineski, 2017). Assertions and inferences about maps that come across as objective and two dimensional are often based on authors' conjectures about the data rather than the voices of those the maps represent. By using publicly available data from many sources I try to mitigate this risk, but it is a concern for my interpretation (Yoon & Libineski, 2017).

GIS Alone ≠ Good Policy. The world is full of functioning information databases and systems; the question for using GIS productively in directing education policy will lie in the system's ability to address a range of problems across organizations (Dunn, Atkins, Townsend, 1997). The answer to this question lies primarily outside of the scope of this study, but for the sake of future use of this research, I provide more context on this limitation.

Making policies based only on GIS is problematic as there is too much room for "conjecture" and "partial representation"; it is crucial to add the voices of the individuals who will be affected by policy changes (Yoon & Libineski, 2017). Marginalized communities are usually negatively impacted by the unintended consequences of using GIS in a "top-down"

manner (Libineski & Lee, 2017). For policymaking to be guided by GIS, it will be crucial to add the voices of community members from the list of potentially impacted sites.

In Chapter 5, I share results for the manual and GIS cases in this study. Early in the data analysis it became abundantly apparent that IAO criteria were not well-suited for the data, due to the number of cases being well beneath the goals for new school construction. In the next chapter, I describe national statistics, differentiate between the national groups and suggested construction sites, and present correlations and linear regression data for the manual case study. None of these metrics were used in the initial analysis to identify sites for new school construction. Additionally, I will outline how the early use of spatial analysis could have influenced IAO to identify district-specific instead of nation-wide selection criteria. I also present spatial analysis of data clustering, low/high score hotspots, and geographic regression. I conclude Chapter 5 with a presentation of "best fit sites" for Kasungu district. Kasungu district was selected due to its size, population, and high prevalence of low-score clustering.

CHAPTER 5: RESULTS

In this chapter, I explore the results of manual and GIS analysis of aid data and IAO practices using the criteria of interest identified by IAO: female pass rates, total pass rates, catering rates, and distance from major roads and existing secondary schools.

In presenting Case #1, the manual case, I begin by sharing descriptive statistics on national performance on the 2016 PSLCE exam and explore how the use of these observations might have influenced IAO criteria-setting throughout the process of selecting sites for new school construction. I then discuss the realities of IAO criteria for new site selection in relation to national performance. Finally, I offer a comparison of the national school population to the group of manually selected sites before sharing a linear regression model that seeks to understand how district and zonal catering rates contribute to female and total student pass rates.

In Case #2, I use spatial analysis to describe how IAO criteria for new site selection relate to the realities of Malawi's education system. I then use spatial techniques to explore clustering and hotspots for student performance. The hotspot analysis is followed by a presentation of geographically weighted regression results, which explore how spatial distance has an effect on female and total student performance on PSLCE exams. Finally, I use location allocation tools to identify potential sites for new construction in the Kasungu district that maximize population coverage.

Ultimately, I conclude through analysis of both cases that IAO criteria for new site selection did not reflect what the data analysis revealed, and that subsequent projects should feature selection criteria specific to the zone or district and not at the national or divisional

levels. Additionally, future projects should include spatial analysis if beneficiaries in rural areas are to be successfully targeted.

Case #1

National Results

Data from MOEST and IAO were combined for an analysis of Malawi's 2016 performance on the PSLCE exam. The results for univariate descriptive statistics describing the mean, maximum, minimum, variance, and standard deviation for total students tested, total students passing, percent females and total students passed, and zonal and district catering rates are presented in Table 2.

Table 2

National Results, 2016 PSLCE

National Frequencies

		Total tested on PSLCE	Total passed PSLCE	Percent females passed	Percent total passed	Zonal catering rate	District catering rate
N	Valid	4829	4829	4803	4829	4828	4829
	Missing	0	0	26	0	1	0
Mean		64	44	61.11%	67.16%	36.43%	39.96%
Minimum		1	0	0%	0%	2.74%	14.96%
Maximum		686	609	100%	100%	312.50%	63.25%
Variance		3447.45	2087.16	.0706	.0514	.0601	147.07
Std. Deviation		58.72	45.69	.2658	.2266	.2452	12.13

The number of students tested at a single primary school range in size from one student to 686, the average number of students tested was sixty-four with a standard deviation of fifty-nine students, suggesting a large data spread. Total students passed reflected similar variance, with an average of forty-four students, a range of zero to over six hundred, and a standard deviation of over fifty-nine students. Nationwide, average pass rates were 67%, with female students

averaging 61%, variance for both was high at twenty-three and twenty-seven percent, respectively; again the large variance and standard deviations suggest data dispersion from the mean. Catering rates at the district and zonal level averaged under 40%, with a wider range at the zonal level than the district level. Zonal catering rates ranged to over 300%. This should not be interpreted as indicating that some secondary schools are not filled to capacity; rather, low pass rates at individual small rural elementary schools inflate this measure. The reader should keep in mind that multiple primary schools feed to a single secondary school and under-enrollment is not a concern. The standard deviation for zonal catering rates is twice as large as that of the district catering rate, reflecting the greater amount of variance at the zonal level.

Students Tested. Across 4,829 primary schools results for over 300,000 Standard 8 students were included in the dataset (n = 307,410). Males represented 54% of the students tested (n = 165,191) and females were 46% of the students tested (n = 142,219). Malawian schools vary greatly in size, and it should be noted that the number of students tested on PSLCE exams is not a true reflection of the national Standard 8 population, as students are excluded for reasons explored in Chapter 4. Still, the data gives some insight on school capacity and the number of students aiming to transition from primary to secondary schools in Malawi. On average, thirty-four males were tested (range/*r* = 0-344) compared to twenty-nine females, class sizes ranged I from zero students to 364, with average testing sizes at sixty-four students; these figures vary greatly once observed at the division and district levels.

Testing rates in the southern divisions are the highest in the nation and reflect the larger population in southern districts (*r* = 91%-57%). The central divisions (*r* = 71%-52%) and sole northern division (*m* = 49%) have testing averages that mirror their population count.

At the district level, testing rates in the urban districts of Blantyre, Lilongwe, Mzuzu, and Zomba (m = 140 students) is nearly double the rate in rural districts (m = 57 students). Testing rates for total students (n < 44) and female students (n > 20) are notably low on average in Ntchisi, Chitipa, Mangochi, Mzimba North, and Nkhata Bay.

Students Passed. Nationwide, 67% of students tested passed the PSLCE exam and were eligible for transition to secondary school (n = 213,965). As seen in Figure 7, Male pass rates were 72% compared to 61% for females—the difference in gender performance is even greater at the division and district level.

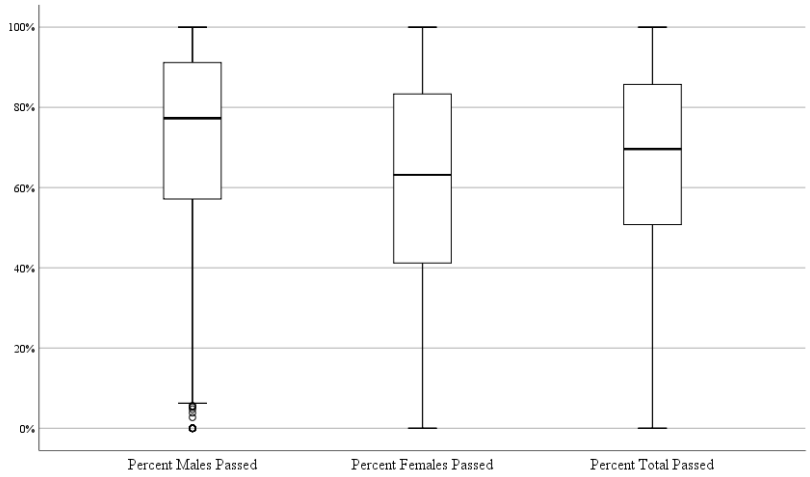


Figure 7. Pass rates by gender

Division-level performance on the PSLCE ranged from 84% in SHED to 57% in NED. The South Eastern Education District (SEED), which includes Balaka, Machinga, Mangochi, Zomba Rural, and Zomba Urban, represented the largest discrepancy between male pass rates (m = 75%) and female pass rates (m = 60%) and tested the fewest number of students (n = 24,436).

The NED division represented the lowest average pass rates at (57%) but tested more students than most divisions (n = 33,383).

District pass rates ranged from 92% in Mulanje to 43% in Chitipa. Mulanje tested more students (n = 8,712) than the district average (n = 6,484). The discrepancy between male and female pass rates were on average, 11% with high rates in Machinga (19%), Mwanza (18%), Nkhotakota, Zomba Rural, Mangochi, and Salima (18%). Notably, these districts are all adjacent to Lake Malawi or located in southern divisions. Male and female pass rates were closest in urban areas and notably low in Zomba, Mulanje, and Lilongwe. In the northern districts, Mzuzu and Mzimba South, female pass rates were higher than male pass rates.

Zonal/District Catering Rates. More than 307,000 students passed the PSLCE exam to qualify for entry to Form 1 in secondary schools. Yet the 2016 Form 1 enrolment was 74,965, with 52% males and 48% females. In 2016, secondary school tuition fees were a significant barrier to student entry, but have since been eliminated. SEED was designed to address capacity constraints, and undoubtedly, similar projects will be needed to make space for the increasing number of students seeking secondary education in Malawi.

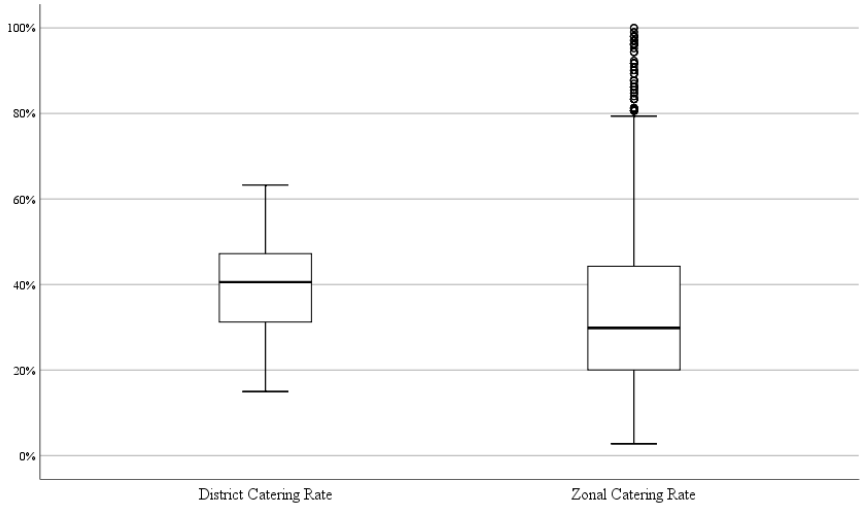


Figure 8. Stem-and-leaf comparison of district versus zonal catering rates.

The district catering rate is, on average, 40% and very similar to the zonal catering rate of 36%. However, the range of the zonal catering rates (r = 3%-312%) better represent the variance found on the local level than the range of district catering rates (r = 15%-63%); even with 115 extreme cases (m > 100%) omitted at the zonal level, as seen in Figure 8.

A visual comparison of district catering rates by division (Figure 9) and district (Figure 10) make clear that the variance in the catering rate was best observed at the individual district level. High catering rates in the northern districts of Mzimba North and South, Nkhata Bay, and Chitipa are visible in Figure 10 and reflected in the divisionally high average. However, the discrepancies in urban catering rates, such as Mzuzu's relatively high rates compared to Blantyre and Lilongwe, are only visible at the district level.

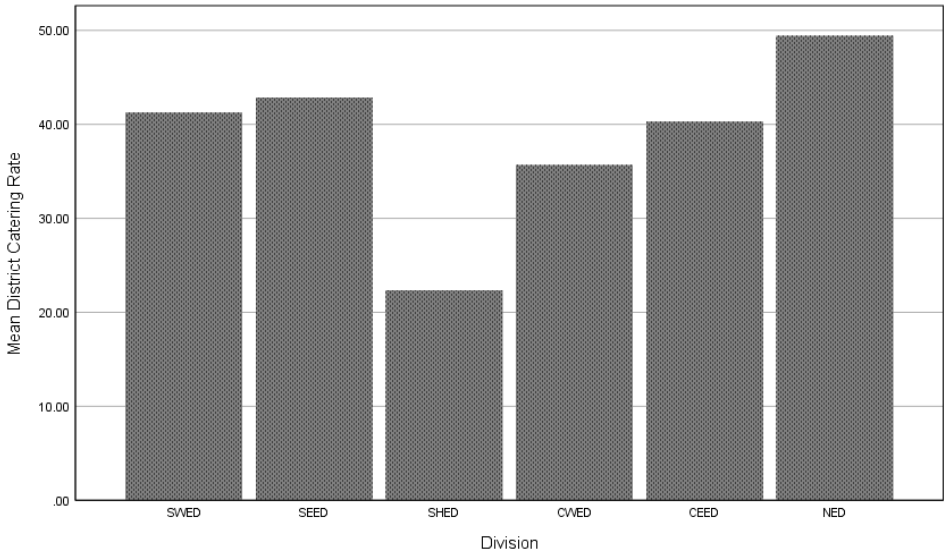


Figure 9. District Catering Rate by Division

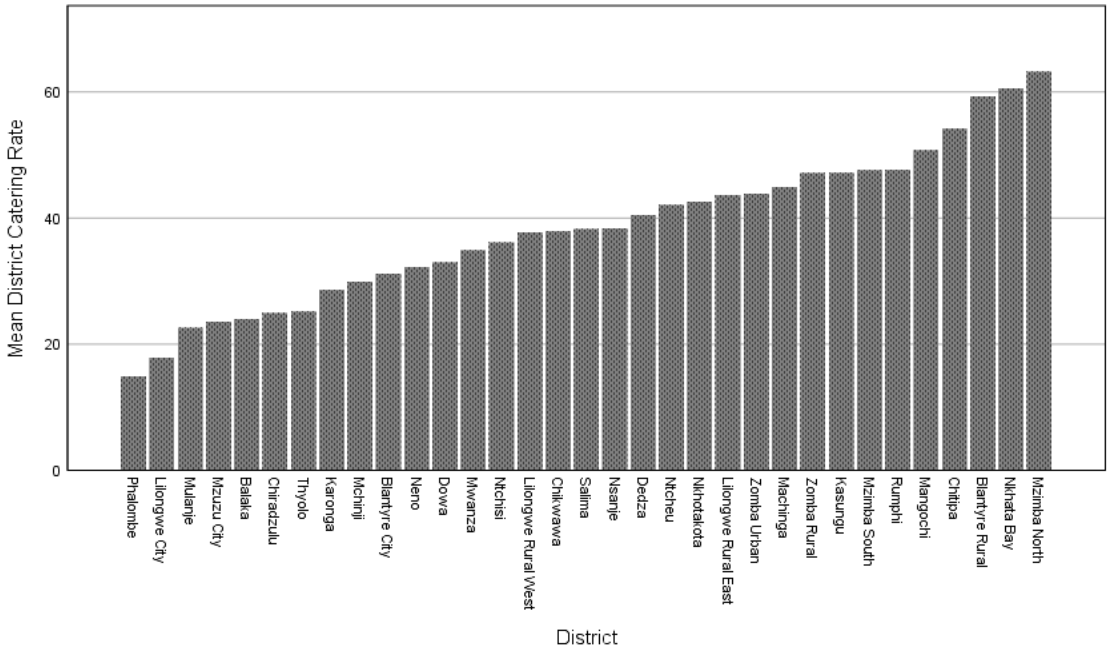


Figure 10. District Catering rates.

In the next section, I review the four statistical components of IAO site selection criteria.

Analysis of Fit of IAO Criteria

The IAO criteria for new secondary school construction prioritized the selection of primary schools that fit the following criteria:

1. > 10km from a main road
2. > 10km from an existing secondary school
3. > n = 50 total students passing PSLCE
4. > n = 25 girls passing PSLCE
5. > 75% PSLCE pass rate
6. Located in a zone with a low zonal catering rate

In this section, I discuss the reasoning for these criteria as well as how exam performance matches the parameters for the number of students passing, overall test score, and zonal catering

rate. In order to do this I observe how many cases in each district fulfill criteria three through six in the order presented above.

Fifty Students Passing. Requiring fifty students to be passing at a given site was based on the average Form 1 capacity of 50 total students. IAO reasoned that by building a school where fifty successful students were already located, there was no risk of building an under-attended school or building in a location where not enough students qualified.

Of the 4,829 schools in the original data set, 1,403 (29%) had greater than fifty students passing the PSLCE. Schools with at least fifty students passing also tended to have larger class sizes (m=95) than the national average of forty-four. Additionally, schools with more than fifty students passing the PSLCE had higher averages of female students passing (76%) and total students passing (80%). The average zonal catering rate was 25%, which was lower than the national average of 36%, indicating that for this group of students there was a higher need for more student capacity (r = 3-90%). Still, the performance of this group of schools is not evenly distributed throughout Malawi. Observations made at the division and district levels make this apparent.

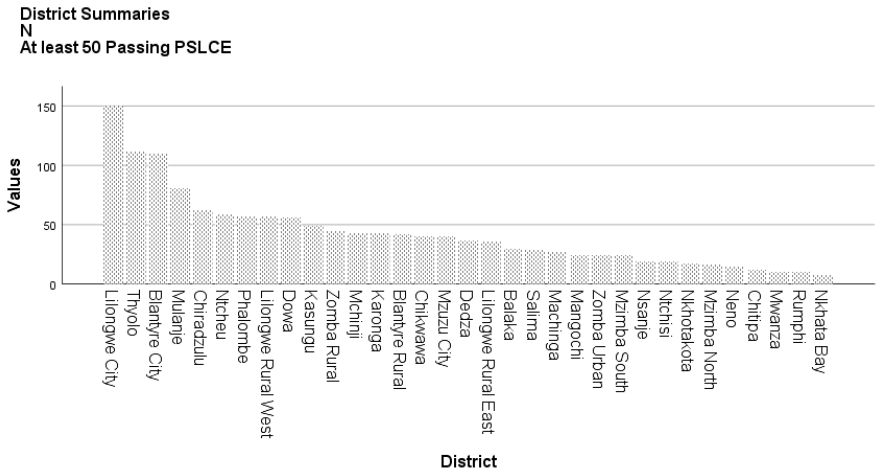


Figure 11. Number of schools with more than fifty students passing by district

Figure 11, makes it clear that the IAO selection criteria for class sizes are well suited for larger and urban districts; however, they are well out of reach for smaller districts such as Nkhata Bay, Rumphi, and Mwanza. Indeed, twenty-four of the thirty-three districts (73%) have fewer than fifty schools that would qualify under these criteria (Appendix #).

Twenty-five Females Passing. In order to encourage gender parity at the new secondary schools, sites under consideration should have at least twenty-five female students successfully pass the PSLCE. For IAO, this meant that new secondary schools would enroll at least 50% of eligible girls because they had a successful population of students to select from.

Of the 1,403 schools with more than fifty students passing, 1,028 (73%) also had at least twenty-five female students pass the PSLCE. This is a highly representative sample as the entire dataset featured only 1,076 schools (22% of the 4,829 schools) with more than twenty-five girls passing. Again, these criteria resulted in higher-than-national averages with these sites averaging 79% pass rates compared to the 61% national average (r=90-64%). Additionally, the performance by gender was separated by only 5% compared to the national average of 11%. In seven, majority northern districts females performed on par with (within 1%) or better than male students—suggesting that primary schools with more than twenty-five girls passing the exam were better at preparing both genders for national exams.

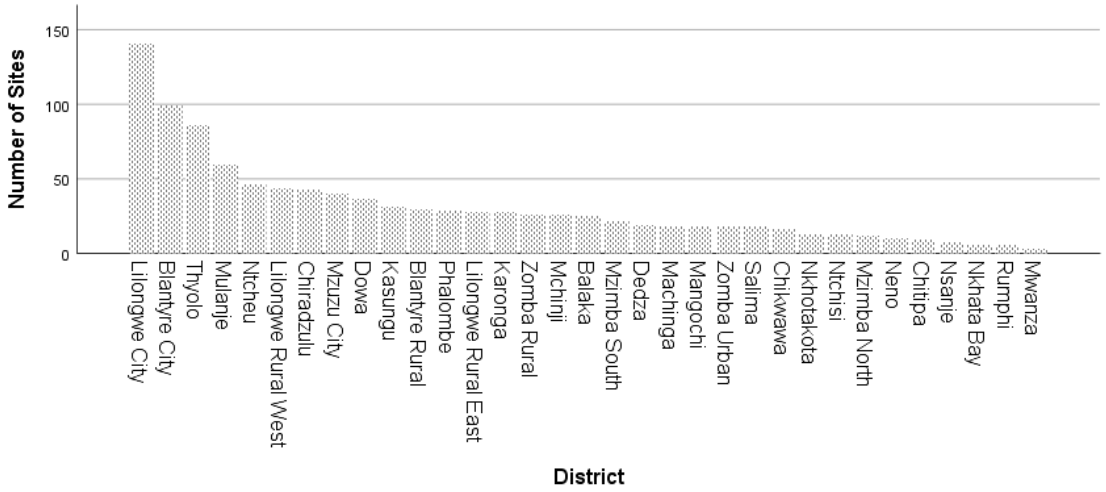


Figure 12. Schools per district with 50 total students and 25 females passing PSLCE.

As seen in Figure 12, the per district sample is extremely small, and candidate locations for all but four districts are less than fifty locations with more than half offering fewer than thirty schools that meet both requirements (Appendix K).

Seventy-five Percent Pass Rate. Pass rate criteria were used to limit the selection of sites with large student populations but generally poor performance. With the seventy-five percent pass rate schools with 500 students examined, but only 100 passing would be ranked behind schools with 100 students examined and eighty students passing.

Of the 1,028 primary schools that had at least fifty total students, among them at least twenty-five girls passing the PSLCE exam, 751 (73%) had pass rates of 75% or better in 2016. The entire sample had 2,084 schools (43% of 4,829) that met the pass rate requirement alone.

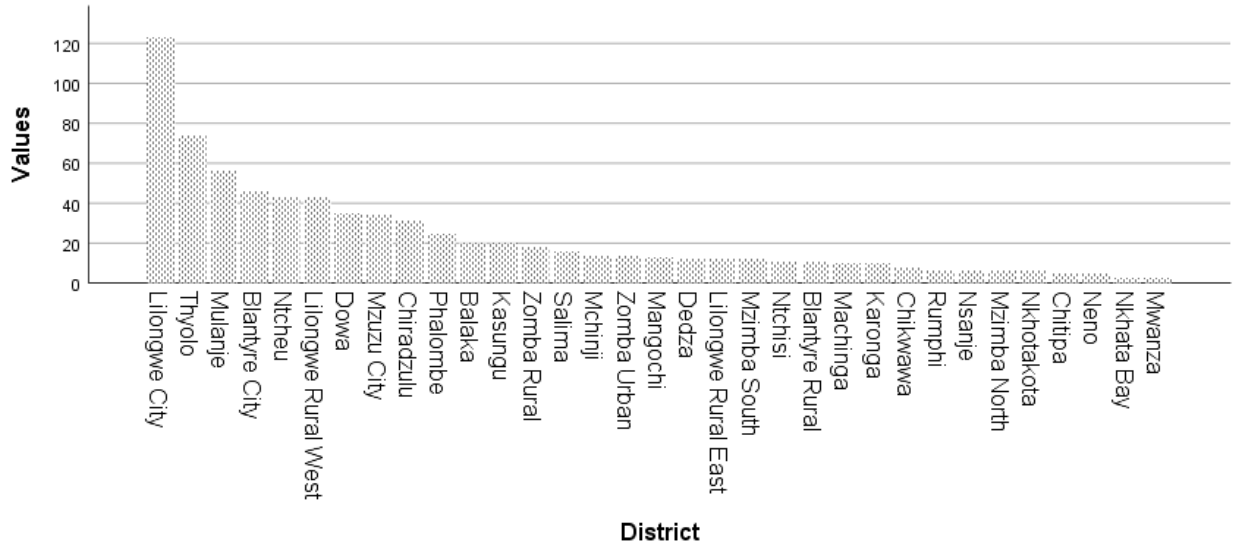


Figure 13. Schools per district with 50 students, 25 females, and >75% Pass rate.

As required by the parameter, pass rates for this group of schools were higher than the national average of 67%, and performance difference by gender was 5%. However, Lilongwe, Thyolo, and Mulanje were the only districts that offered more than fifty candidate sites (Figure 13). The remaining twenty-nine districts had fewer than 46 sites, each with less than fifty in more than half of those districts (Appendix L).

Zonal Catering Rate. The zonal catering rate criteria were used in order to prioritize new school construction in areas that were already producing more students than the current infrastructure provided for. The sample of 751 sites was further filtered for sites with a zonal catering rate less than the national average of 36%, leaving 653 potential sites (87%) of the sample remained. In the national sample, 2,928 schools (61% of 4,829) fit these criteria. The catering rates range from 19-33%, as compared to the national range of 3-100%.

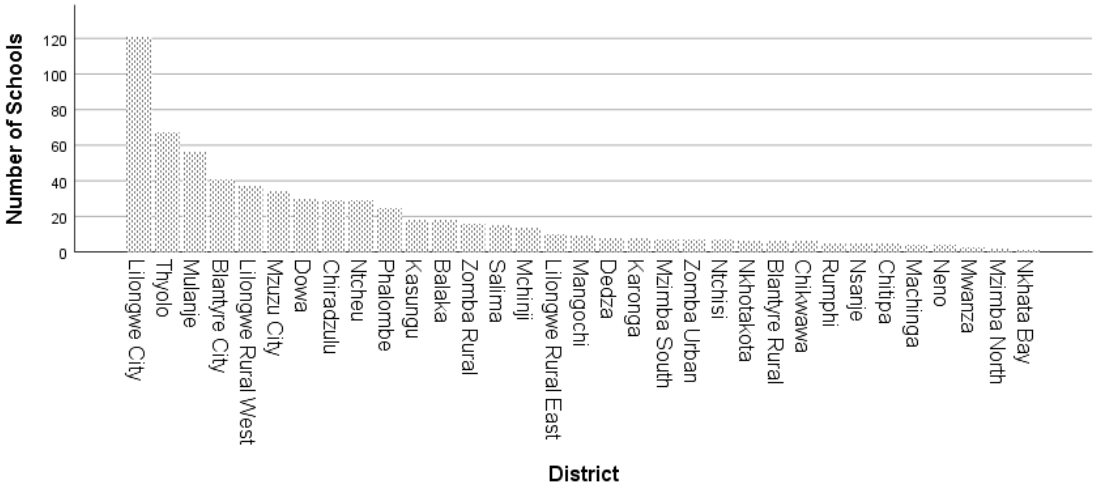


Figure 14. Schools per district with 50 students, 25 females, >75% Pass, low zonal cater.

The group of schools that meet these four criteria (number of students, number of females, pass rate, and low zonal catering) demonstrates exceptional levels of performance on the PSLCE exams. Still, as seen in Figure 14, they are concentrated in the capital city of Lilongwe. More than half of the districts have fewer than ten sites that meet all four of the outlined criteria (Appendix M). Ultimately, seventy-one of the primary schools that met these criteria for total students passing, female students passing, overall pass rates, and low zonal catering rates were recommended as sites for new school construction (44 first choice, 27 alternates). While the IAO criteria successfully identified primary schools that were high-performing, the criteria were well-suited for only a small number of districts and favored the higher examination, pass, and performance rates of urban areas.

In this section, I have discussed the fit of IAO selection criteria based on school performance and concluded that the criteria were in most cases, too restrictive to present enough potential build sites. It should be noted that the criteria for selection were not strict; these were flexible guidelines used to identify sites. In the next section, I present a comparison of the

selected (first choice and alternate) and unselected groups before discussing data correlations and a regression model.

Comparison of Selected Sites and National Results

Manual spatial analysis, along with the criteria outlined in the previous section were used as guidelines for selecting sites for new school construction. In this section, I offer a comparison of the selected and non-selected group with the caveat that the selected group includes manual spatial analysis that is not reflected in data for the non-selected sites. Between four and seven first choice sites and four and seven alternate sites were selected for all districts regardless of the number of existing schools or population size.

Table 3

Comparison of Selected and Non-Selected Sites.

Selected Sites Summaries							
School Selected		Total tested on PSLCE	Females passed	Percent females passed	Total passed	Percent total passed	Zonal catering rate
Not Selected	N	4531	4531	4505	4531	4531	4530
	Mean	62	18	60.34%	43	66.41%	37.12%
	Minimum	1	0	0%	0	0%	2.74%
	Maximum	686	326	100%	609	100%	312.50%
	Variance	3396.88	525.14	.072	2024.37	.052	.062
	Std. Deviation	58.23	22.92	.2679	44.93	.2289	.2497
First Choice / Alternate	N	298	298	298	298	298	298
	Mean	83	28	72.7%	65	78.64%	25.98%
	Minimum	20	1	10%	12	30%	5.18%
	Maximum	452	202	100%	351	100%	98.04%
	Variance	3830.13	761.42	.040	2587.96	.022	.015
	Std. Deviation	61.88	27.59	.1990	50.872	.1481	.1228

Table 3 suggests the procedure at IAO was largely successful at identifying sites of desirable characteristics across all districts, but the range of results should be noted. The group of selected schools, on average, had higher numbers of students passing (sixty-five compared to

forty-four nationally) and higher total pass rates (79% compared to 66% nationally) with a range of 12 and 351 students (Appendix N). Selected sites generally tested more students and passed more female students than the non-selected groups, with an average of 73% of females passing versus the non-selected female pass average of 60%. However, the number of passing females is, on average, below the suggested level of twenty-five in all but seven districts (Appendix O).

While the selected group on average met the criteria for a 75% pass rate the district-level performance was varied, as nine districts did not meet these criteria on average (Appendix P) Finally, the selected group averaged catering rates of 26%, which is lower than the national average of 37%, but the selected sites ranged between 5-98% (Appendix Q). Lower catering rates indicate a greater demonstrated need for increased secondary school capacity.

Regression and Multi-level Modeling Analysis

The IAO criteria for site selection were based on ideal characteristics for a newly constructed secondary school in a resource-strapped environment: gender parity, enrollment at full capacity, high-performing students from rural populations. These criteria were developed separately from the data used to select sites and were not re-evaluated during the selection process. Additionally, metrics were developed by IAO. In this section, linear regression and multi-level modeling are used to determine how the IAO criteria respond to the data set. Multi-level modeling is linear regression, but with controls for the nested nature of data; instead of presenting only the nation-wide model, a multi-level model accounts for differences at the district and division levels. Three models are presented to determine how selected factors affect test scores; the IAO model, Malawi model, and combined model. As this is a predictive-model for determining optimal sites, all assumed mediating criteria are included in one model rather than building a case on a single effect.

The first model observes the IAO criteria, low district catering rates, and low zonal catering rates. This model is intended to observe what affect, if any, the independent variables have on total and female pass rates. The second model is a simulation of Government of Malawi selection criteria based on the 2016 EMIS report. The MOEST models uses the ratios of pupil to qualified teacher, pupil to permanent classroom, and promotion rate—three variables measure by the Government of Malawi and presented by MOEST in its annual state of the sector report; this regression model is intended to observe if the criteria measured by the Government of Malawi have a similar or greater impact on total and female test scores. The third model includes both the IAO and MOEST measures and is designed to observe whether the combined analysis of both the IAO and MOEST criteria could together explain more of the variance in total and female pass rates.

Linear regressions rely on the assumption that schools in different locations are different from one another. Educators know this is not always true, as schools of low and high performance are often located near one another. In order to mediate for the "neighborhood effect," regression models were observed with no controls for division or district and then re-analyzed with multilevel modeling, adding controls for division, district, and the interaction of division and district. In the next sections, I share the results of the regression models followed by results for the multi-level models that control for district, division, and the intersection of division and district.

Variable Screening. The dependent variables are total percent passing PSLCE and female percent passing PSLCE. While both IAO and MOEST report on the interest of schools that further the education of girls, as seen in Table 4, the overall pass rates and female pass rates are highly correlated variables and it is predicted that the model will demonstrate similar results

for both variables. Both dependent variables were screened for normality using a histogram and determined to be sufficiently normal.

Table 4

Correlation of Total and Female Pass Rate

		Percent females passed	Percent total passed
Percent females passed	Pearson Correlation	1	.895**
	Sig. (2-tailed)		.000
	N	4803	4803
Percent total passed	Pearson Correlation	.895**	1
	Sig. (2-tailed)	.000	
	N	4803	4829

**p< 0.01

The independent variables of district cater rate, zonal cater rate, student to teacher, student to qualified teacher, and promotion rate were screened using histograms to determine the range and natural breaks in data groups. To mediate for extreme influences in the model, the independent variables were divided into groups based on scores and then separated by the use of dummy variables. In Table 5 and in the regression models, these groups are presented in order of ascending desirability.

Table 5

Independent Variable Groups in Order of Desirability

	IAO Regression		MOEST Regression		
	District cater	Zone cater	Students-per-classroom	Students-to-teacher	Promotion rate
Group 1	> 50%	80-100%	< 75	47-64	63-71%
Group 2	40-50%	60-80%	75-100	68-77	56-61%
Group 3	30-40%	40-60%	100-125	78-85	< 49%
Group 4	< 30%	20-40%	125-150	86-107	
Group 5		< 20%	> 150		

IAO Regression Analysis. In Table 6, the IAO regression model is presented as an estimate for how the IAO determined factors of district and zonal catering rate affect total percent passing at the school level. All coefficients are significant at the .001 level except for the 20-40% Zone Cater group, which is not significant. The findings, while significant, suggest the inverse of the expected results. As the capacity for successful students goes up (increased district and zonal catering), the negative effect of test scores gets larger and overall offers a negative impact on total pass rates.

The largest coefficient in the >50% district cater group suggests that as catering rates go higher, the effect on total percent passing in a negative twenty percentage points on the PSLCE. The group of >50% district catering includes Nkhata Bay, Mzimba North, and Blantyre Rural, a geographically diverse group of relatively large districts. It is possible the range of test scores in these urban and peri-urban districts might be influencing outcomes or that a mediating factor smaller than the district is needed before the model is used in decision-making.

Table 6

IAO Regression, Total Percent Pass

Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. error	Beta	t	Sig.
1	(Constant)	78.427	.698		112.324	.000
	>50% District Cater	-20.690	1.030	-.351	-20.088	.000
	40-50% District Cater	-13.649	.902	-.286	-15.136	.000
	30-40% District Cater	-8.956	.909	-.167	-9.851	.000
	80-100% Zone Cater	-6.023	1.815	-.048	-3.319	.001
	60-80% Zone Cater	-6.897	1.403	-.076	-4.915	.000
	40-60% Zone Cater	-3.598	.992	-.063	-3.627	.000
	20-40% Zone Cater	1.467	.797	.032	1.839	.066

a. Dependent Variable: Percent Total Passed

Table 7 demonstrates similar results when the model is used to observe the percentage of females passing as an independent variable, suggesting a more negative effect of increased district catering and mixed effects of zonal catering.

Table 7

IAO Regression, Total Female Percent Pass

Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. error	Beta	t	Sig.
1	(Constant)	73.403	.836		87.850	.000
	>50% District Cater	-21.328	1.230	-.309	-17.344	.000
	40-50% District Cater	-13.326	1.078	-.238	-12.360	.000
	30-40% District Cater	-9.981	1.088	-.159	-9.177	.000
	80-100% Zone Cater	-5.200	2.170	-.036	-2.396	.017
	60-80% Zone Cater	-8.607	1.674	-.081	-5.143	.000
	40-60% Zone Cater	-5.068	1.185	-.076	-4.276	.000
	20-40% Zone Cater	.578	.953	.011	.607	.544

a. Dependent Variable: Percent Females Passed

Simulated MOEST Regression Analysis. The results of the simulated MOEST model offer similarly unexpected results. In the simulated MOEST model, all of the independent variables are significant at the .05 level, however the inverse of the expected effect on total percent passing is observed. Table 8 suggests that as the number of students per classroom goes up, pass percentages at the school level go up. Additionally, this regression model suggests that as the promotion rate goes up, the percentage of students passing the PSLCE goes down significantly.

Table 8

Simulated MOEST Regression, Total Percent Passing

Coefficients[a]

		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. error	Beta	t	Sig.
1	(Constant)	73.39	1.82		40.24	.0000
	<75 Students per Class	-16.45	2.06	-.1717	-7.97	.0000
	75-100 Students per Class	-13.95	1.68	-.2633	-8.31	.0000
	100-125 Students per Class	-3.02	1.47	-.0625	-2.05	.0400
	125-150 Students per Class	5.29	1.48	.1079	3.57	.0004
	47-64 Students to Teacher	29.50	1.68	.3032	17.57	.0000
	68-77 Students to Teacher	7.96	.9938	.1573	8.01	.0000
	78-85 Students to Teacher	5.90	.9125	.1272	6.47	.0000
	56-61% Promotion Rate	-7.86	1.46	-.1614	-5.39	.0000
	63-71% Promotion Rate	-10.26	1.35	-.2206	-7.61	.0000

a. Dependent Variable: Percent Total Passed

This model suggest that the number of students per qualified teacher may have the most positive impact (30 percentage points) on student test scores when the ratio is less than 64 students per classroom. However, the results also show the complexities of the control variables

due to the presence of positive and significant beta values. Therefore, results must be interpreted with caution, as well as noting the caveat that the highest number of qualified teachers are found in Malawi's urban areas. The districts in this group include Lilongwe and Mzuzu City.

Table 9

Simulated MOEST Regression, Female Percent Pass

Coefficients[a]

Model		Unstandardized coefficients		Standardized coefficients		
		B	Std. error	Beta	t	Sig.
1	(Constant)	68.33	2.18		31.35	.0000
	<75 Students per Class	-18.69	2.47	-.1667	-7.58	.0000
	75-100 Students per Class	-14.55	2.01	-.2340	-7.25	.0000
	100-125 Students per Class	-3.64	1.75	-.0643	-2.07	.0382
	125-150 Students per Class	2.43	1.77	.0423	1.38	.1691
	47-64 Students to Teacher	32.34	2.02	.2813	16.04	.0000
	68-77 Students to Teacher	9.21	1.19	.1553	7.74	.0000
	78-85 Students to Teacher	6.61	1.09	.1215	6.05	.0000
	63-71% Promotion Rate	-11.31	1.61	-.2074	-7.02	.0000
	56-61% Promotion Rate	-7.05	1.74	-.1234	-4.04	.0001

a. Dependent Variable: Percent Females Passed

In Table 9, similarly surprising results for the female percent pass groups are noted. All independent variables are significant at the .05 level except the 125-150 students per classroom group. This model suggests that test scores are more negatively impacted by a lower number of students in class for female students than for all students. Promotion rates also appear to have an overall negative effect on test scores. As more students are promoted, female pass percentages go down by eleven percentage points. This data must be interpreted in conjunction with the earlier mentioned practice of some schools preventing qualified students from progressing to Standard 8 because of hesitation that they will be able to pass the PSLCE. Likewise, the large positive

estimated effect of teacher-to-student ratios on female percent passing must be understood within the urban context.

Combined Regression Analysis. The results of the combined model correspond to earlier trends in the regression model (Noted in Table 10). Even with the larger predictive model, test scores do not appear to be positively impacted by a higher district catering rate, increased zonal capacity, fewer students per classroom, or higher promotion rate. Decreasing the number of students per qualified teacher appears to have the only overall positive affect on the total number of students passing. and the negative impact gets smaller as the catering rate goes down and fewer students advance from primary to secondary school.

For the zonal catering rate, the impact is significant and largely negative although the negative impact increases as zonal catering ability go down. The results for the ratio of permanent classrooms in the combined model are also mixed—more classrooms per student seem to have a negative impact on test scores, and the effect gets smaller as more students are added.

Additionally, in the combined model, fewer students per qualified teacher had an even more positive impact on test scores, which appeared to be the biggest for the smallest classrooms. Also, lower promotion rates appeared to impact pass percentages negatively.

Table 10

Combined Regression Analysis, Total Percent Pass

Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients		
Model		B	Std. error	Beta	t	Sig.
1	(Constant)	84.30	1.93		43.63	.000
	>50% District Cater	-15.94	1.11	-.2710	-14.29	.000
	40-50% District Cater	-6.00	1.03	-.1260	-5.82	.000
	30-40% District Cater	-1.61	1.06	-.0300	-1.52	.128
	80-100% Zone Cater	-4.90	1.77	-.0390	-2.77	.006
	60-80% Zone Cater	-7.82	1.38	-.0860	-5.69	.000
	40-60% Zone Cater	-3.15	.9710	-.0550	-3.24	.001
	20-40% Zone Cater	1.45	.7830	.0320	1.85	.064
	<75 Students per Class	-10.61	2.04	-.1110	-5.21	.000
	75-100 Students per Class	-10.97	1.67	-.2070	-6.58	.000
	100-125 Students per Class	-3.55	1.45	-.0730	-2.44	.015
	125-150 Students per Class	2.54	1.49	.0520	1.70	.089
	47-64 Students to Teacher	18.37	1.81	.1890	10.16	.000
	68-77 Students to Teacher	6.95	.1000	.1370	6.98	.000
	78-85 Students to Teacher	1.54	.9360	.0330	1.65	.099
	63-71% Promotion Rate	-12.59	1.40	-.2920	-9.72	.000
	56-61% Promotion Rate	-8.74	1.43	-.1790	-6.10	.000

a. Dependent Variable: Percent Total Passed

The results of the regression model should be interpreted with caution, as previously discussed, though they are similar for female students (Appendix R). The inverse effects of some predicted positive factors may be a result of the over-representation of urban districts in some groups. The results also suggest that a unit of interpretation smaller than the national level is needed to understand the difference in total percent pass and female percent pass at the school level. In the next section, I present results for multi-level modeling, a regression analysis that accounts for data clustering at the divisional and district levels.

Multilevel models for the IAO, simulated MOEST, and combined model were examined at the divisional level, district level, and where district and division overlap. For each of the three models the district-level control was found to be insignificant, and the combination of district and division was similar to district results. As such, the smaller districts were used for multilevel analysis, and the results are shared in the next three sections.

IAO Multilevel Model. In Table 11, the results when controlling for district show a significance at the .001 level.

Table 11

IAO Multilevel Model, Total Percent Pass, controlled for District

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		385.16	7.96	48.37	.000	369.86	401.09
Intercept [subject = district]	Variance	49.11	13.38	3.67	.000	28.79	83.76

a. Dependent Variable: Percent Total Passed.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	94.67	4.24	30.55	22.34	.000	86.02	103.31
Zonal Cater	-.1682	.0177	4694.46	-9.50	.000	-.2029	-.1335
District Cater	-.5309	.1060	31.32	-5.01	.000	-.7469	-.3149

a. Dependent Variable: Percent Total Passed.

The estimates of fixed effects show a small but significantly negative effect on percentage passing at the school level when controlling for district. In the IAO model, zonal

catering has a negative sixteenth of a percentage point effect on school-level pass rates, while district catering rates have a negative half a percentage point on school-level pass rates.

Simulated MOEST Multilevel Model. In the simulated MOEST model, divisional differences are not significant, but district-level differences are significant at the .001 level, as seen in Table 12.

Table 12

Simulated MOEST Multilevel Model, Total Percent Pass, controlled for District

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		396.39	8.09	48.97	.000	380.83	412.57
Intercept [subject = district]	Variance	74.28	20.23	3.67	.000	43.55	126.68

a. Dependent Variable: Percent Total Passed.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	113.80	19.85	29.46	5.73	.000	73.22	154.38
permclassratio	.2870	.0776	29.07	3.70	.001	.1283	.4457
pupilqteach	-.5593	.1679	30.78	-3.33	.002	-.9018	-.2168
promrate	-.5525	.2885	29.06	-1.92	.065	-1.14	.0375

a. Dependent Variable: Percent Total Passed.

While the estimated fixed effects for the simulated MOEST model offer more of an explanation than the IAO model, the effects are relatively small and explain less than one percentage point of difference on the effects of permanent classrooms, qualified teachers, and promotion rates on school pass percentages.

The results of the simulated MOEST model indicate that as the ratio of permanent classrooms goes higher, percentage passing goes up—an inverse effect from the expected outcome. As the number of students to qualified teachers goes up, percentage passing goes down by half a percentage point, and as the promotion rate gets higher, the percentage passing decreases by half a percentage point. Again, these small and unexpected outcomes should be interpreted with caution; there are likely mediating factors below the district level that the multilevel model does not account for.

Combined Multilevel Model. The combined model is significant at the .001 level when controlled for district-level difference (Table 13), but differences at the divisional level are not significant.

Table 13

Combined Multilevel Model, Total Percent Pass, controlled for District

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		385.12	7.96	48.37	.000	369.83	401.05
Intercept [subject = district]	Variance	30.33	8.90	3.41	.001	17.07	53.90

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	134.92	13.49	28.44	10.00	.000	107.30	162.54
permclassratio	.1577	.0546	28.01	2.89	.007	.0459	.2696
pupilqteach	-.3320	.1170	31.50	-2.84	.008	-.5704	-.0937
promrate	-.5813	.1891	27.71	-3.07	.005	-.9689	-.1937
zonalcater	-.1671	.0177	4698.73	-9.44	.000	-.2018	-.1324
districtcater	-.4312	.0914	29.50	-4.72	.000	-.6179	-.2444

a. Dependent Variable: Percent Total Passed.

In the combined model, the independent variables have an overall small, but significant, impact on school-level pass rates. In the combined model, the IAO criteria explain less of the variance in test scores than they do in the separate IAO model at a sixteenth of a percentage point for zonal catering and less than half of a percentage point for district catering. For the simulated MOEST criteria, permanent classrooms and qualified teachers appear to have a smaller effect on school-level pass percentages in the combined model than in the separate model, while the promotion rate has a larger negative effect.

The results of the regression model suggest that the manually formulated criteria for selected school sites do not provide a sufficient model for estimating variance in test scores. Even when input from MOEST is simulated, the district-level indicators do not seem to be specific enough to explain the variance in total or female percent passing. The surprising results of the regression and multilevel models suggest that the manual methods and criteria for selecting new school sites, do not adequately reflect the criteria that explain variance in test scores. If IAO aims to build new schools in areas that successfully pass students from primary to secondary school, new criteria and regression models will need to be considered.

In the Malawian context, where new school construction, qualified teachers, and increased capacity are severely needed inputs, it is concerning that both linear regression and multilevel modeling do not account for much of the variance in the percentage of students passing the PSLCE at the school level. These unexpected outcomes suggest that a mediating factor beyond the national, divisional, and district level is having an effect on total percent passing.

In the next section, I present the results for the GIS methodology. The use of spatial analysis allows for zonal-level observations for fewer than 25 schools versus the manual

methods, which were constrained to district-level analysis of hundreds of schools. The unit of analysis is not a constraint inherent to manual methods but is a result of the data set used for analysis. Despite this roadblock in manual methods, the GIS case study is able to build "neighborhoods" based on geographic proximity.

Case #2

The second case is designed to explore whether GIS is a viable option for increasing opportunities for local ownership in international aid projects such as school construction. In order to assess the fit of GIS use for IAOs, the second case explored how the same IAO- and simulated MOEST-identified criteria can be used in spatial analysis and how the results of data analysis with GIS might inform future school construction projects.

The GIS case results are discussed through a presentation of spatial analysis tools used in ESRI's ArcGIS Pro. I begin by offering a description of national and selected sites. I then present the results for hotspot analysis, clustering, density, and geographically weighted results. Results for the manual case revealed that below-district-level specificity should be required for site selection criteria; as such, Kasungu is used a demonstration district, and all reporting is completed for the national level and Kasungu district for comparison.

The rural Kasungu district is one of the single most populous districts in Malawi, with the highest number of primary (n=296) and secondary schools (n=41). Kasungu district is also the district I am most familiar with due to her familial ties to the area. Despite high numbers of schools, Kasungu performs at or below average on most district-level performance metrics with a 47% district catering rate. Kasungu's low performance rates are, at least in part, due to the influence of the dwindling tobacco industry. Known as Malawi's "green gold" in the 1960s, tobacco has contributed largely to deforestation, flooding, unstable incomes, and low schooling

rates in Kasungu, and while it remains the nation's top export product, farming rates and incomes from tobacco have plummeted in the past two decades.

In Table 14, it is apparent that despite its historic wealth and political power, Kasungu has lower averages on nearly every indicator. Yet, the range of values offered by this large district makes it an ideal candidate for spatial displays of zonal variation. In addition to its relatively large size and performance on national indicators, Kasungu also presents a strong case for its geographic diversity. The northwestern area of Kasungu hosts Kasungu national park and is largely void of population but represents the larger navigational consideration for populations in relation to natural features such as lakes, mountains, and parks. Kasungu has both highly populated urban areas and less dense rural areas, uncovered by primary roads.

Table 14

Comparison of Kasungu and National statistics.

National Frequencies

		Total tested on PSLCE	Total passed PSLCE	Percent females passed	Percent total passed	Zonal catering rate	District catering rate
N	Valid	4829	4829	4803	4829	4828	4829
	Missing	0	0	26	0	1	0
Mean		64	44	61.11%	67.16%	36.43%	39.96%
Minimum		1	0	0%	0%	2.74%	14.96%
Maximum		686	609	100%	100%	312.50%	63.25%
Variance		3447.45	2087.16	.0706	.0514	.0601	147.07
Std. Deviation		58.72	45.69	.2658	.2266	.2452	12.13

Kasungu Frequencies

		Total tested on PSLCE	Total passed PSLCE	Percent females passed	Percent total passed	Zonal catering rate	District cater rate
N	Valid	296	296	294	296	289	296
	Missing	0	0	2	0	7	0
Mean		54	31	49.57%	54.35%	38.27%	47.2%
Minimum		6	0	0%	0%	10.73%	47.2%
Maximum		364	271	100%	100%	100%	47.2%
Variance		1453.173	888.164	707.102	556.041	404.948	0
Std. Deviation		38.120	29.802	26.5914	23.5805	20.1233	0

While the features highlighted for Kasungu could be discussed for any district in Malawi, the limitations of APA styling and standard letterhead do not allow the space to display the national distinctions properly.

Coordinate Information. Nationwide, coordinate information for 71 secondary schools (10% of 745 sites) and 148 primary schools (3% of 4,849 sites) is missing. In Kasungu district, coordination information for one secondary school (2% of forty-one sites) and two primary schools (<1% of 296 sites) is missing; Figure 15 offers a visual projection of these sites in Kasungu.

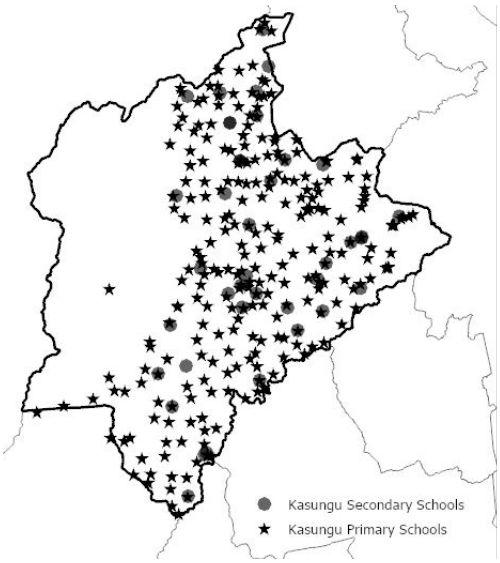


Figure 15. Primary and Secondary Schools in Kasungu

In the next section, I present spatial analysis of the IAO criteria, with particular attention given to the spatial criteria.

Assessment of Spatial Criteria

Distance from Major Roads. Of the 4,829 schools analyzed, only 397 primary schools (8%) are located more than 10km from a major roadway. As shown in Figure 16, the majority of schools are located fewer than two kilometers from a major roadway. In this instance, the IAO criteria were not defined in relation to the data and are thus potentially restrictive to the point of ruling out otherwise suitable sites for consideration. Schools in the rural districts of Thyolo and Mwanza, had the highest distance to major roads (Appendix T).

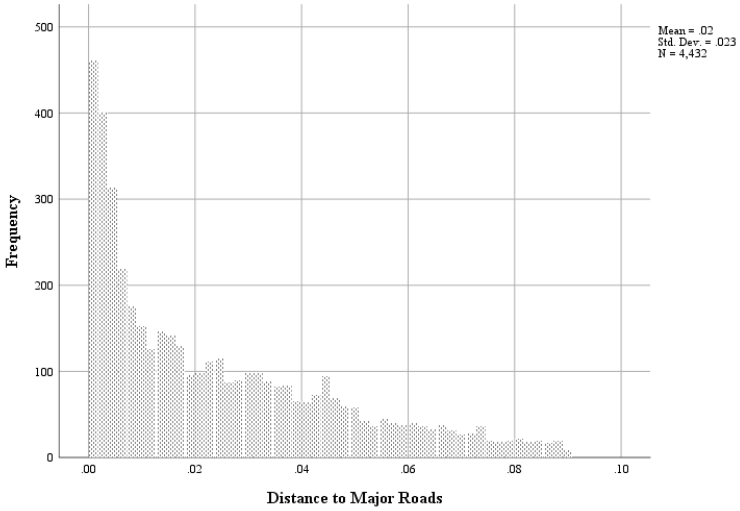


Figure 16. Distance from Primary Schools to Major Roads

Of the 398 schools selected as potential sites, twenty (7%) were located greater than 10km from a major roadway. Still, the highly restrictive distance-to-roads criterion is marginally reflected in a comparison of selected and non-selected sites. On average, selected sites are one-tenth a kilometer (2.5km) further from existing roadways than non-selected sites (2.4km). Figure 17 offers the Kasungu selected sites as a visual reference of proximity to roadways.

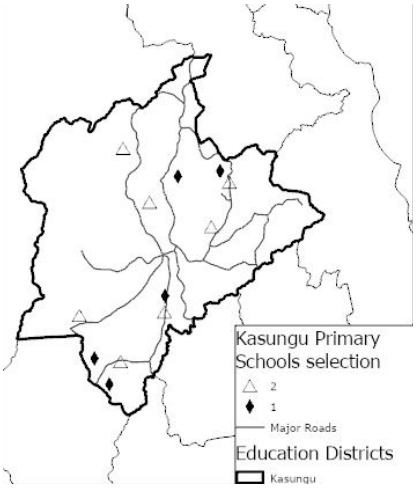


Figure 17. Distance from Primary Schools to Major Roads, Kasungu

Distance from Existing Secondary Schools. Of the 4,829 schools, 376 (8%) are located more than 10 kilometers from an existing secondary school. Due to the small number of schools

that fit the IAO- designed criteria, this section discusses the 92% of schools nationwide that fall within the ten-kilometer buffer. Figure 18 shows that primary schools are located at greater distances from secondary schools than they are from major roadways.

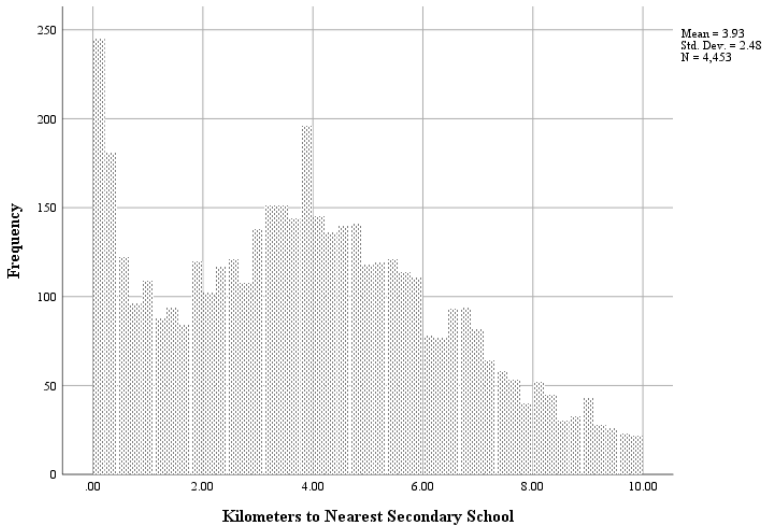


Figure 18. Distance to Nearest Secondary School

While it is possible to intuit this based on the ratio of existing secondary schools to primary schools (.16), the histogram provides clarity on the fact that the 10km distance is not as restrictive for the distance from secondary schools as it is from primary schools. Unlike the roadways distance, each district approaches the 10km desired buffer from secondary schools. Still, the distance limits the selection sample to 8% of the population, whereas a more realistic buffer may have been five kilometers, which would be slightly above the national average of four kilometers (Appendix U). Thirty-four of the selected sites (11%) are located more than ten kilometers from an existing site and all of the manually selected sites are located at least one kilometer from an existing secondary school, these sites are not included in Appendix U. On average selected sites were located five kilometers from existing secondary schools compared to the 3.8-kilometer average for non-selected sites.

Selected Sites. The selected sites are more representative of the desired spatial criteria. Additionally, the use of manual methods for selection did not result in cluster groups of high-performing schools, as is visible in Figure 19. The sites selected in Kasungu are not clustered in the urban center but are distributed throughout the landscape.

Ultimately, the manual methods produced a set of 298 above-average primary schools according to the IAO criteria. However, As discussed in Case 1, these criteria were constructed for the entire nation without consideration of district-level differences.

Figure 19. Kasungu selected sites.

In the next section, I offer visualizations of district and zonal level indicators as potential solutions. The presentation of the division and district variance should encourage future site selection with criteria differentiated by the district level at least. For zonal-level depictions, all primary school data was merged with MOEST zonal polygons, which contain between two and twenty-five schools. Data for each primary school was merged to create zonal averages, and analysis was completed using the zonal average.

Variance in Variables at District and Zonal Levels

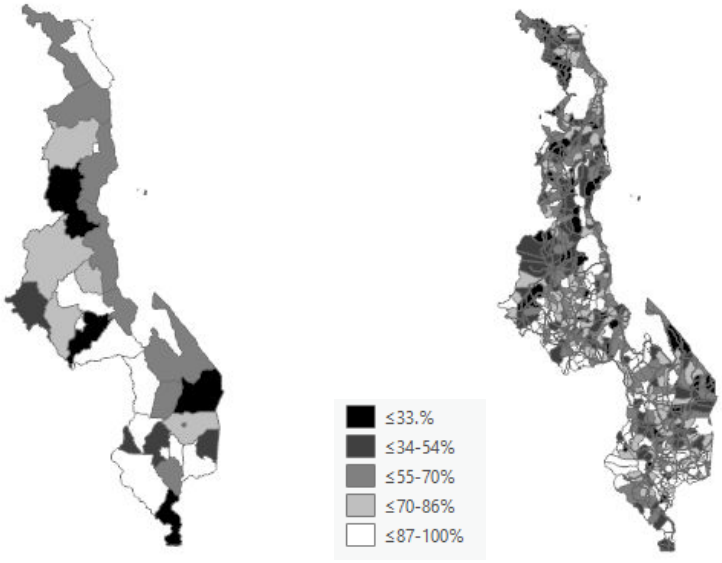


Figure 20. Total Percent Pass, District and Zonal values.

Total Percent Pass. Figure 20 displays outliers of high and low values for the total percent pass at the zonal level. Lower test scores are represented by darker colors, and within-district variation is immediately visible. A geographic trend of pass rates in the 70-86% range is located along the lakeshore region; it is easily apparent in Figure 20, but invisible at the divisional level.

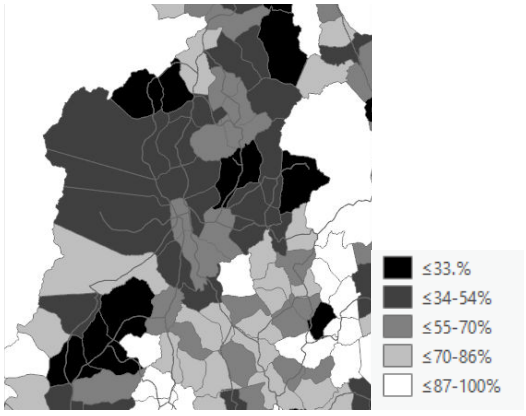


Figure 21. Total Percent Pass, Kasungu

In Figure 21, the variation in test score pass rates is visible at the individual district level. Immediately, IAO and MOEST could use the above diagram to identify the variance in performance in Kasungu district as well as potential sites to target for new school construction.

District and Zonal Catering. In Figure 22 a comparison of district catering by zone and district level is visible. At the zonal level, it is possible to view variations within districts as well as gradients around hot and cold spots.

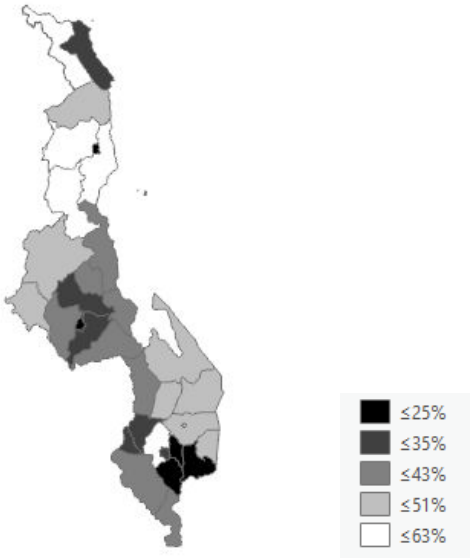


Figure 22. District Catering Rates by district

Observing zonal catering rates by zone in Figure 23, it is possible to see with more clarity the benefits of district-level analysis. In the southern region, cold spots around the highly populated urban areas of Blantyre are surrounded by the more rural, red spots where capacities are greater and student populations lower.

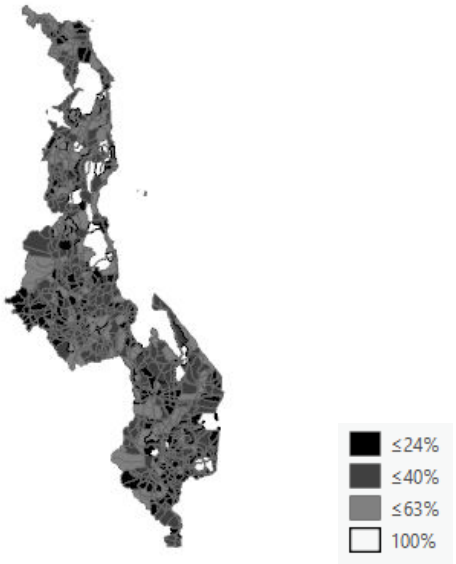


Figure 23. Zonal Catering Groups, Malawi.

In Figure 24, the detail of zonal-level analysis becomes more apparent as areas of high need, represented by darker shades, are immediately visible and thus possible to target as priority sites for new school construction.

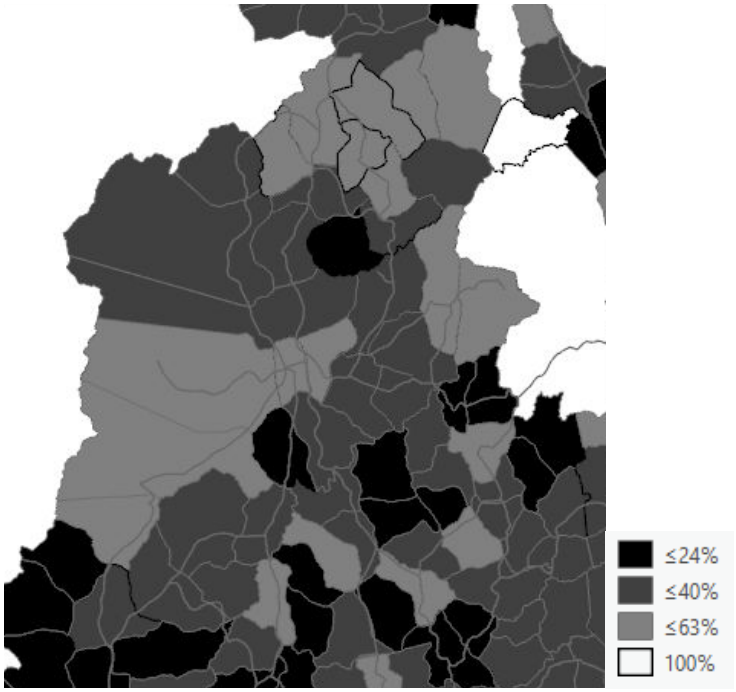


Figure 24. Zonal Catering Rates in Kasungu.

Student-to-Permanent Classroom. Figure 25 allows a comparison of zonal and district rates for pupil-to-classroom ratios at the national level. Ratios are desirably lower in the sparsely populated northern regions, even around the urban Mzuzu City.

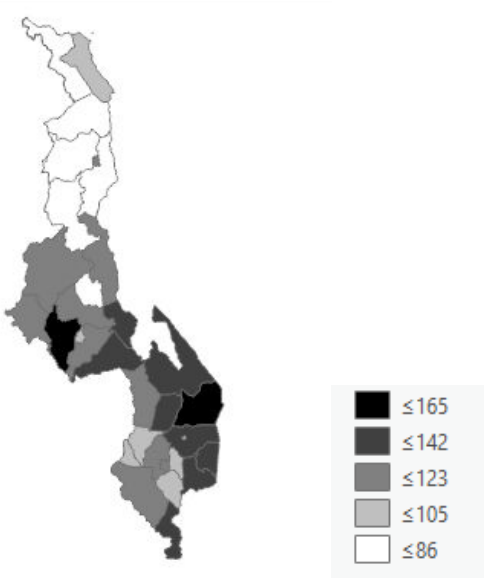


Figure 25. Student to Permanent Classroom Ratio, Malawi

Kasungu, when viewed separately in Figure 26, is largely at the national average for student-to-permanent classroom; however it is surrounded to the north by cold spots and to the south by hotspots.

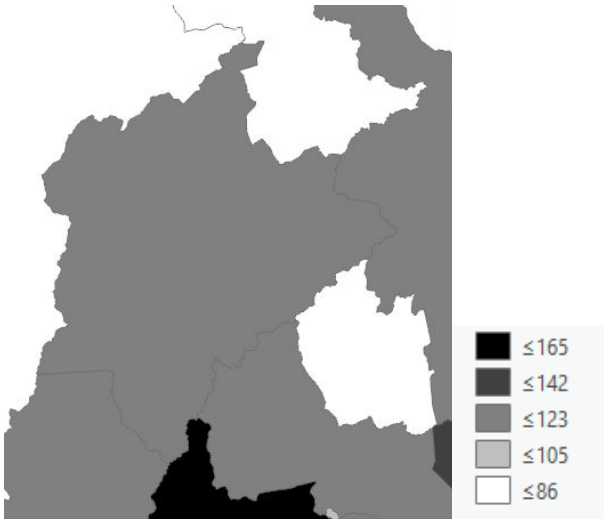


Figure 26. Student to Permanent Classroom Ratio, Kasungu

Student-to-Qualified-Teacher. The proportion of qualified students to teachers is expectedly high in the urban regions of Lilongwe and Blantyre. However, hot spots are also visible in Kasungu and in the Mangochi Lake region. Figure 27 provides a comparison of the national and regional levels.

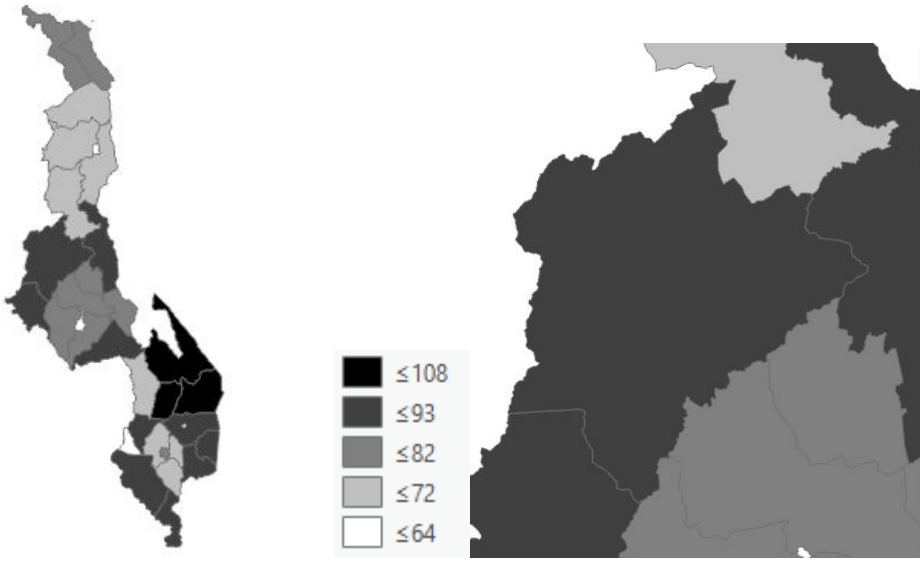


Figure 27. Pupil to Qualified Teacher Ratio, Malawi, Kasungu

Promotion Rate. Promotion rates were grouped into three categories, less than 49%, 56-61%, and 63-71%. Figure 28 shows high rates of promotion in the capital city of Lilongwe and low rates in Blantyre's urban district. Together, IAO and MOEST might develop criteria specific to these areas for desired outcomes of increased attendance in secondary schools.

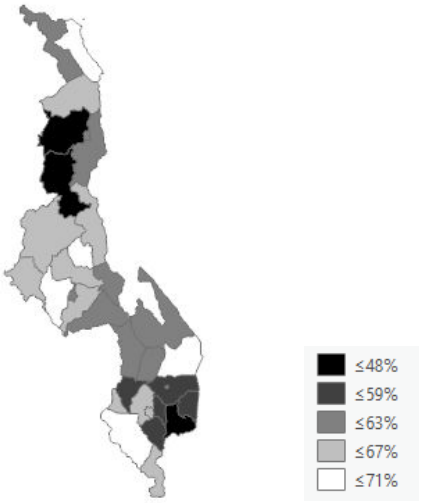


Figure 28. Promotion Rates, Malawi.

The visual depictions of this data offer opportunities for IAO and MOEST to create site selection criteria that correspond to realities at the district and zonal levels and their variation across divisions. Instead of blindly creating nationwide criteria or assuming that divisional differences offer adequate categories for differentiating outcomes, the visual displays created in ArcGIS make clear the variance in outcomes is not easily grouped into existing categories and would be better explored through district- or zonal-specific contexts.

Kernel Density Analysis

Using the kernel density analysis tool, a geodesic density analysis was completed on all located secondary schools using the secondary total capacity as the population field and a cell size of .0683, with no search radius specified—because the search radius was not specified, all

rural schools were considered within the analysis rather than being excluded due to their distance from other schools. Figure 29, reveals that secondary schools are concentrated in urban settings, particularly Lilongwe and Blantyre, the center of the darkest regions of the map.

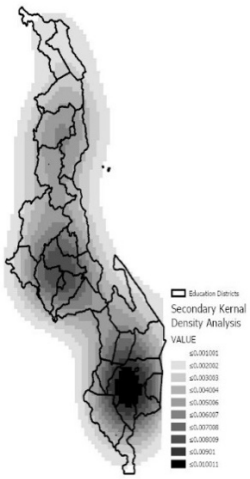


Figure 29. Kernel Density of Secondary Schools.

Global Moran's I

Global Moran's I is a test for spatial correlation of a variable based on a calculated z-score and p-value. Given a set of values, the global Moran's I will calculate whether a set of values are clustered, disperse, or random and the statistical significance of the findings. The national data for Malawi was analyzed using the global Moran's tool on zonal and school level data for number of students tested, total percent pass, female percent pass, and zonal catering rate using no distance or threshold band and an inverse difference to conceptual data, so that closer features had greater impact on one another than more distant features.

Table 15

Global Moran's I results for Zonal and School data.

	Spatial Correlations	Moran's Index	z-score	p-value	Distance Threshold
Students tested	Clustered	2.6	78.53	0.00	19.17 km
Total % Pass	Clustered	2.68	80.80	0.00	19.17 km
Female % Pass	Clustered	2.72	81.98	0.00	19.17 km
Zonal Cater	Clustered	.3559	10.72	0.00	19.17 km

Table 15 suggests high clustering on school and zonal data at the .01 significance level. The extremely high z-scores and significance at the .001 level suggest that the risk of a false positive is very low and that within a nineteen-kilometer radius the number of students tested, total and female percent pass, and zonal catering rates are extremely clustered. Throughout Malawi, schools with high test scores are surrounded by others with high test scores and schools with low test scores are generally surrounded by other schools with low test scores. Global Moran's I evaluates clustering on a population level and seeks to understand dispersion from a global perspective, so in order to further explore clustering patterns the Anselin Local Moran's I was used. These results are presented in the next section.

Anselin Local Moran's I

After observing high levels of clustering of independent variables, Anselin Local Moran's I was used to observe how the spatial auto-correlation varied at the local level, if at all. Local Moran's I in ArcPro generates a z-score, p-value, and cluster/outlier type. A high, positive z-score indicates similar features are surrounded by each other, high-high or low-low clusters. A low, negative z-score indicates spatial grouping of high-low and low-high clusters, such as schools with high pass rates are likely to be located next to a school with a low pass rate.

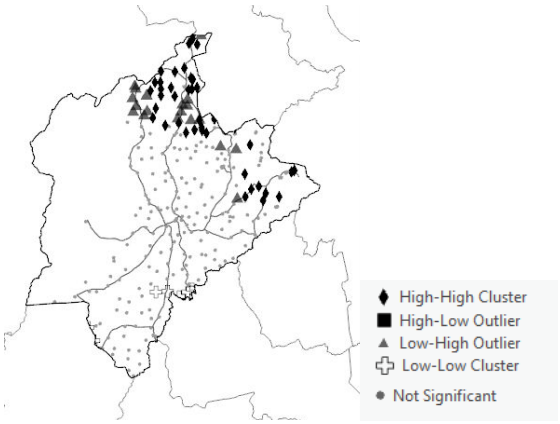


Figure 30. Zonal Catering Clusters, Kasungu

Exploration using local Moran's I offers too many results to sensibly view at the national level. In Figure 30, results for Kasungu show that high-high and low-high pairings are concentrated in the northeast region. An understanding that a majority of the Kasungu district has a relatively normal zonal catering rate with significantly different clusters in the northeast region might guide MOEST and IAO to target new school construction in this region towards specific areas.

Table 16

Female Cluster groups, Selected and Non-Selected

Female Pass Cluster	School selected (Y/N)	# of schools
Not Significant	Not selected	2853
	First choice/alternate	207
	Total	3060
High-High Cluster	Not selected	601
	First choice/alternate	46
	Total	647
High-Low Cluster	Not selected	171
	First choice/alternate	18
	Total	189
Low-High Cluster	Not selected	173
	First choice/alternate	5
	Total	178
Low-Low Cluster	Not selected	561
	First choice/alternate	21
	Total	582

Table 16 reveals that of the selected sites, most were chosen in non-significant clusters followed by high-high clusters. IAOs interested in impacting female pass rates might consider new school construction in areas of high-low and low-high clusters where new schools might offer sites for the mingling of the two outlier groups. Cluster types by number of selected and non-selected schools for total pass rate data and zonal catering rate are in Appendix V and show that the most significant selected sites were located in low-low zonal catering clusters and high-high total pass rate clusters. IAO designed criteria meant to select exceptionally high-performing schools and succeeded in identifying these sites in areas where they are surrounded by similarly high-performing schools.

Getis-Ord Gi*

Getis-Ord Gi* is a spatial analytical tool that compliments Moran's I, allowing for the identification of data hotspots of high and low rates. The hot spot analysis tool was used on the district-, school-, and zonal- level data using an inverse relationship, Euclidean distance, and a correction for false discovery rate.

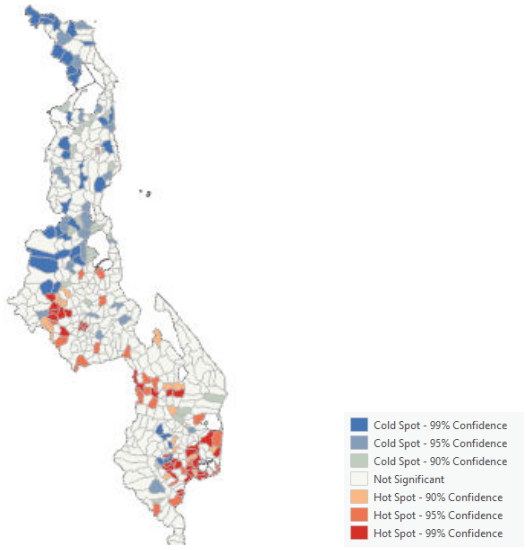


Figure 31. Total Percent Pass Hotspots, Malawi

Total Percent Pass. Figure 31 displays outliers of high and low values for the total percent pass at the zonal level. Blue gradients represent lower test scores, while red gradients represent higher test scores. Gray areas represent average performance. A geographic divide between the northern region and the central and southern regions is visible where cold spots are dominant in the North, and hot spots are more present in the south.

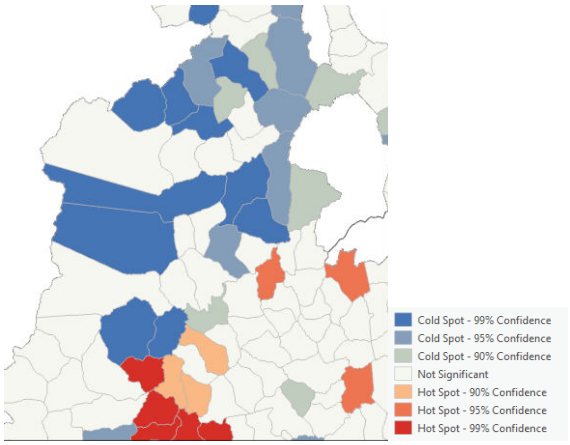


Figure 32. Total Percent Pass Hot spots, Kasungu

In Figure 32, the variation in test score pass rates is visible at the district level. Immediately, IAO and MOEST could use the above diagram to identify the variance in performance in Kasungu district as well as potential sites to target for new school construction.

District and Zonal Catering. In Figure 33 a comparison of district catering by zone and district level is visible. At the zonal level, it is possible to view variations within districts as well as gradients around hot and cold spots.

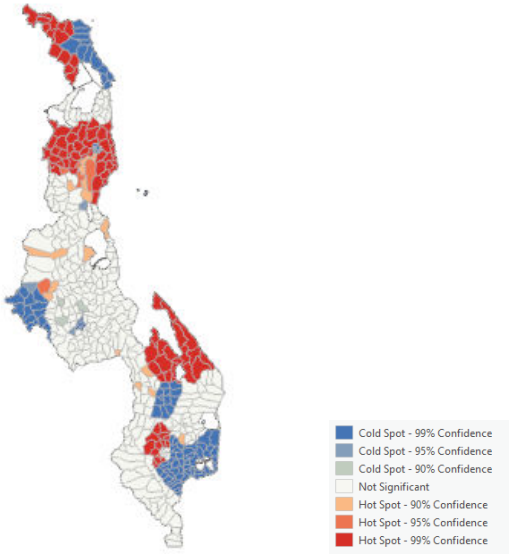


Figure 33. District Catering Hotspots by district

Observing zonal catering rates by zone in Figure 34 it is possible to see with more clarity the benefits of district-level analysis. In the southern region, cold spots around the highly populated urban areas of Blantyre are surrounded by the more rural, red spots where capacities are greater and student populations lower.

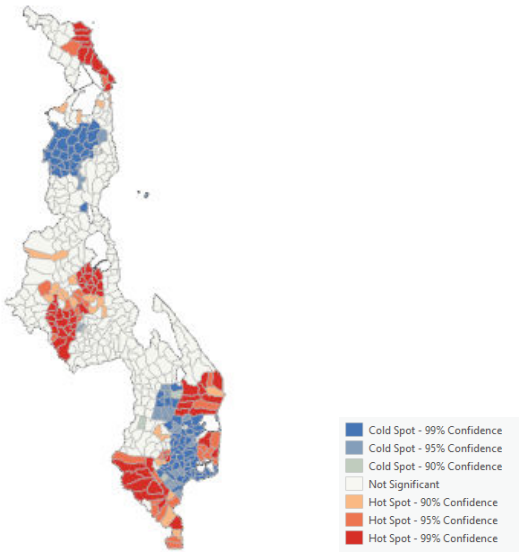


Figure 34. Zonal Catering Rate Hotspots, Malawi.

In Figure 35, the detail of zonal level analysis becomes more apparent as areas of high need, represented by lighter shades, are immediately visible and thus possible to target as priority sites for new school construction.

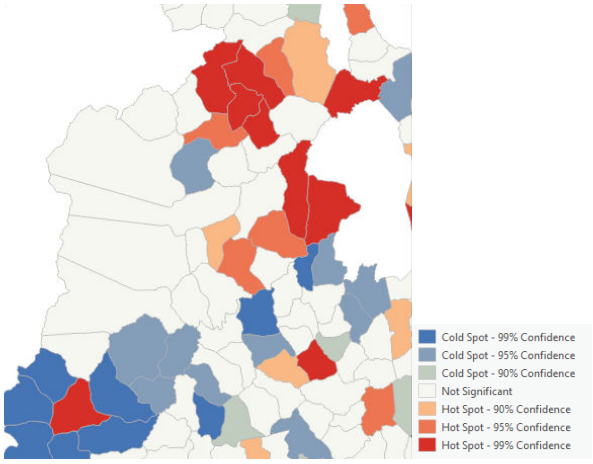


Figure 35. Zonal Catering Rates in Kasungu.

Student-to-Permanent Classroom. Figure 36 allows a comparison of zonal and district rates for pupil-to-classroom ratios at the national level. Ratios are desirably lower in the sparsely populated northern regions, even around the urban Mzuzu City.

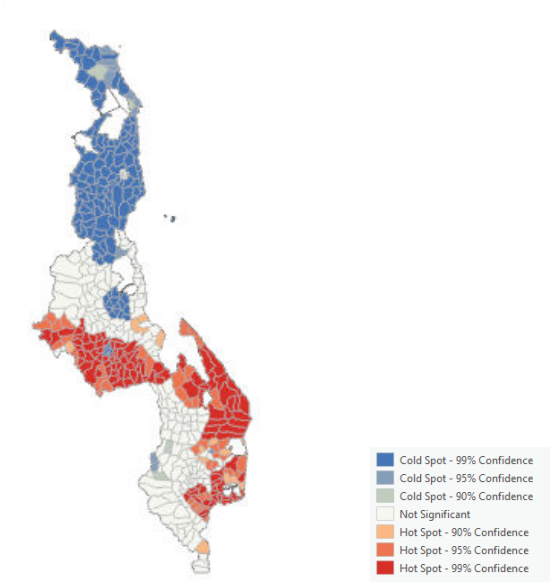


Figure 36. Student to Permanent Classroom Ratio, Malawi

Kasungu, when viewed separately in Figure 37, is largely at the national average for student-to-permanent classroom, however it is surrounded to the north by cold spots and to the south by hotspots.

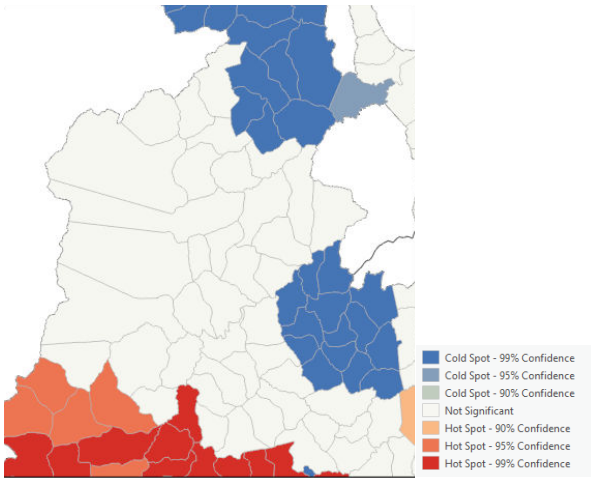


Figure 37. Student to Permanent Classroom Ratio, Kasungu

Pupil-to-Qualified-Teacher. The proportion of students to qualified teachers is expectedly high in the urban regions of Lilongwe and Blantyre; however, hot spots are also visible in Kasungu and in the Mangochi lake region as seen in Figure 38.

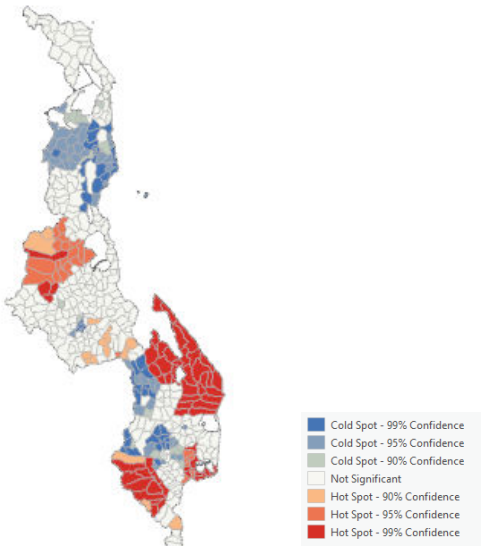


Figure 38. Pupil to Qualified Teacher Ratio, Malawi

Promotion Rate. Promotion rates were grouped into three categories, less than 49%, 56-61%, and 63-71%.

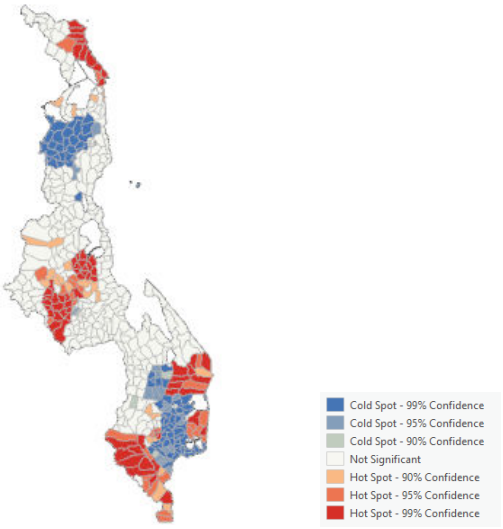


Figure 39. Promotion Rate, Malawi.

Figure 39 shows hot spots of promotion in the capital city of Lilongwe and significantly cold spots in Blantyre's urban district. Together, IAO and MOEST might develop criteria specific to these areas for desired outcomes of increased attendance in secondary schools.

This section shared visualizations of identified hot and cold spots that can be used by IAO and MOEST to identify optimal sites for new school construction. Another method offered by GIS is the use of location-allocation software. In the next section, I present results for the location allocation analysis in Kasungu.

Location-Allocation Results

Location allocation is an analytical tool in ArcGIS Pro that can be used to solved questions of where to build sites. Results can be analyzed using several problem types, including minimize impedence, maximize attendance, maximize capacitated coverage, and maximize coverage. The results presented in this section are for a "maximize coverage" solution based on ESRI's network analysis layer for rural drive times. Software limitation prevents analysis of walking distances greater than twenty-eight miles, and rural drive time was used as the closest substitute.

Figure 40. Comparison of Location Allocation results to Manually selected sites, Kasungu.

The analysis for twelve sites in the Kasungu district was completed with no sites the same as those selected by IAO. However, Figure 40 shows that the majority of GIS-selected sites are in close proximity to IAO-selected sites, suggesting that both methods produce a similar selection.

Side-by Side Comparison

Ultimately the results of the manual and GIS cases provided two very different results for consideration.The results of the manual case made clear that the nationwide criteria set by IAO were too general for the variance of Malawi's districts. Indeed, even when controlling for division- and district-level differences, the IAO criteria did little to explain differences in school and female achievement on the PSLCE exam. Using simulated MOEST input and a combined IAO/MOEST regression model did not explain variances in school-level test score data. The manual case suggests that zonal- and school-level critieria should be identified in future school construction projects in order to identify criteria that do not unintentionally bias urban areas.

For the manual case, a comparison of the selected and non-selected sites in terms of IAO criteria revealed that IAO was successful in nominating sites that had higher average test scores on the PSLCE. The IAO-selected sites were on average high-achieving schools with better results on all IAO-identified critiera than the non-selected group. Yet, the selected sites were not a monolith, and a number of the selected sites did not meet the "twenty-five females" passing criteria that would have ensured gender parity in enrollment.

In terms of ownership, the manual case provided little opportunity for MOEST to be involved in the criteria setting or site selection phases. The sheer amount of time needed for manual analysis limits the number of criteria that IAO can analyze as well as opportunities for involvement from MOEST.

The GIS case offered a clear depiction of the zonal and district variation in IAO criteria. The variation at the zonal and school level were not easily grouped into regional or divisional differences and were more commonly identified as urban/rural divides and lake region phenomena. The within-district variation in IAO criteria was extremely high, with signficant levels of clusters for high and low test scores, suggesting that scores were not randomly dispersed but that common outcomes were grouped in specific areas. Further exploration using Local Anselin revealed that while high-high and low-low clusters did exist at the local level, high-low and low-high clusters of data were also common.

There are also clear opportunities for increasing local ownership in the GIS case. These opportunities are most obvious in the ability to use visualizations at the district and zonal level. These much smaller datasets allow IAO the opportunity to discuss planning and strategy with MOEST on a district-by-district basis. For example, IAO policymakers in partnership with MOEST could design future school construction projects in high-low or low-high clusters that seek to transfer resources and teaching techniques in these areas of great variance from high-achieving schools to those who do not perform as well on the PSLCE. Additionally, MOEST, if invited as a partner on future prijects, can incorpate it's vast database of annually collected, geo-coded data and allow for site selection that incorporates more criteria than possible with manual analysis.

The integrated case analysis included spatial analysis of the manually selected sites, selection of new sites using GIS methodology, and a comparison of the manual- and GIS-selected sites. Spatial analysis of the manually selected sites revealed that the IAO critera for distance from major roadways and existing secondary schools were not good fits for the data; only 8% of schools fit either criterion. While the manually selected sites were, on average,

located farther from existing secondary schools and major roadways than the national average, the GIS analysis suggests that a five kilometer buffer would have been more realistic.

The ArcPro Location-Allocation tool was used to select sites that would maximize coverage of non-covered primary schools, ultimately giving the highest number of primary schools access to a new secondary school. For the GIS case, the IAO criteria and simulated MOEST criteria were not considered. Despite this, the Kasungu analysis revealed that while the GIS methodology produced an entirely different set of schools, the locations of the newly identified sites were not at great geographic distances from the manually selected sites. Ultimately, this suggests that both the manual and GIS methods produced suggestions for sites that were demographically different but geographically close, despite the use of different criteria for site selection.

The integrated case analysis suggests that the GIS case presents optimal opportunities for increasing ownership principles because of the time saved in manual analysis and due to the ability to visualize specific district and zonal areas for partnership and growth rather than a reliance on a nationwide set of evaluation critiera. Still, the GIS case would not have been possible without the hours of analysis completed during the manual case study. While the GIS results were more actionable than those of the manual case, these methodologies are complimentary and results from both cases suggest that data analysis for macro-level policy questions would benefit from inclusion of both methods.

Another major takeaway from the side-by-side comparison is that the IAO and simulated MOEST criteria do not explain significant amounts of variance in school pass rates. If the ultimate goal is to increase the number of students passing the PSLCE, IAO and MOEST will need to work together to identify criteria and analytical levels that are well-suited for the data.

Fortunately, this process will require little effort from both donor and recipient nations—decades of development systems implementation in Africa has birthed annual collection surveys at the school level that are housed within ministries of education. In order to effectively identify optimal sites for new school construction, IAO will need to partner with MOEST and other local government officials for cooperative data sharing and analysis that is not exclusively completed at IAO offices. Realistically, it will mean sending teams from IAO to MOEST and MASDAP offices in order to identify and link IAO construction goals with the rich amounts of school-level data housed by MOEST. Future analysis should not be limited to the number of files conveniently stored on a portable hard drive.

Ultimately, the results presented in Chapter 5 reveal that criteria-setting at the national, divisional, and even district levels do little to explain variance in test scores using manual methods. While the GIS case provided smaller, zonal-level analysis that was immediately actionable and allowed for increased ownership opportunities, the true test of the emerging GIS methodologies in international aid to education will be implementing partnerships throughout the process for greater data inclusion and, ultimately, more powerful and accurate direction on how aid can influence education systems in Malawi and throughout Africa.

CHAPTER 6: CONCLUSION, RECOMMENDATIONS, AND FUTURE RESEARCH

Educators with expertise in international education agree that one of the next frontiers for public education is to ensure quality education for Africa's poorest, yet this "question of Africa" is not unique to the education sector. Healthcare, technology, and manufacturing all grapple with the relatively low economic productivity in Africa while largely choosing to overlook existing unequal systems and centuries of unfair trade, war, and genocide that beget today's global north/south divide. Today's educational, infrastructure, and other "gaps" in Africa are, in many ways, a natural result of colonialism, neo-liberalism, and flawed aid practices (McCowan & Unterhalter, 2015; Mkandawire, 2014).

Focusing on international aid to education in Africa, this research traced a brief history of aid in southern and eastern Africa, with special attention to Malawi. After identifying the lack of ownership principles in previous aid practices, I outlined how new GIS methodologies (including qualitative, mixed methods, and critical GIS) are relevant to education research and how they might provide opportunities for true ownership principles in aid relationships. I then used a mixed-methods case study to explore whether GIS or manual methods provided more opportunities for ownership in identifying new sites for IAO school construction. Ultimately, I conclude that while GIS holds potential for increasing ownership opportunities, realizing these potential benefits will require partnership between IAOs and recipient nations. While GIS is not a silver bullet for issues in aid to education, the technology, if properly implemented, could help create actionable policy that is truly owned by local governments and create real change the for

the populations that need it most. In the next sections, I review the research conclusions before offering more general conclusions and directions for future research.

International Aid & Education in Africa

At independence, many African nations inherited school systems that were exclusive, segregated, and historically used to serve the needs of colonial governments. The hierarchy of the global north and south was designed by the western nations who benefit most from it and is sustained through present-day systems that operate on principles that good things are designed by wealthy nations for import to a "developing" world that can only advance by following in the footsteps of the world's presently powerful nations.

Under this logic, international aid to education can be a context-blind undertaking that focuses on test scores and economic growth while ignoring people and places. This human capitalist view of aid to education is the base philosophy of a large amount of the current international aid to education, but it is not the only type of aid. Post-colonial, Marxist, Freirean, and rights-based aid can create powerful change in education systems. Yet any aid that does not respect the population it serves or the resources they bring to the table is destined to fail. The donor community's reliance on economic outcomes and high-stakes test scores to define what a quality education should result in, and the willingness of SACMEQ nations to accept this definition in exchange for aid, ultimately threatens the possibility of long-term success in aid relationships.

Donors have utilized global funds, project aid, and randomized control trials in attempts to improve quality in African education systems with lackluster results due to their unwillingness to incorporate ownership principles in aid projects. Global funds often ignore systemic issues; an African Development Bank Report in 2000 indicated that their projects included little or no

consultation with stakeholders or beneficiaries and were plagued by high costs (Gakusi, 2010). Likewise, project aid and randomized controlled trials (RCTs) offer fiscal control to the donor community but often create "islands of excellence amidst seas of disadvantage." Currently, funding decisions are often allocated based on donor convenience and the expediency of delivering performance indicators (Gakusi, 2010).

While the aid community is aware of the need for increased ownership principles, IAOs have a long way to go in addressing how recipient nations are involved in aid to education.

Education and GIS

Issues of ownership in aid to education are inherently issues of where. Malawi is repeatedly mapped as static, poor, hungry, needy, and deficient. Instead of focusing on the people and places within the country's borders, the single story of Malawi is represented through dire statistics. This creates a vicious cycle where in-nation diversity of outcomes is erased and well-intentioned researchers and policymakers who repeatedly follow the narrow paths tread by others' bias.

New GIS methodologies such as critical, qualitative, mixed-methods, and non-quantitative GIS seek to empower other ways of knowing people, nations, and places through data visualization and spatial mapping. These new GIS methodologies will be critical in successfully combining GIS and education research for findings that empower under-served communities and provide actionable insight for policy makers. GIS is a flexible tool that can be used to represent both the quantitative data behind geographical features and the qualitative data that responds to meaning and existence—the result of combining these different sets of data are dynamic visualizations that are neither static nor two-dimensional (Crampton, 2011). For researchers, new GIS methodologies means a commitment to recognizing GIS as a negotiated

power relation in knowledge production, instead of a singular, constant mapping (Pavlovskaya, 2009). Thus, MMGIS cannot exclusively be considered as an addition of qualitative research to quantitative questions but must also include qualitative modes of analysis to traditionally quantitative research practices.

For both manual and GIS methods, the task of selecting sites for school construction is a multi-layered process due to the large number of possible locations for construction; contradicting objectives and requirements from communities and school officials; intangible and unquantifiable objectives around what makes a site "good" for a school; diversity of stakeholders; uncertainty of construction impact on the broader community; and validity of decision-making (Eldrandaly, 2013). While new GIS methodologies do not immediately solve the myriad of challenges inherent in selecting sites for new school construction, they do allow for an exploration of alternative narratives by not limiting visual displays and analysis to quantitative data exclusively (Yoon, Gulson, & Libineski, 2018).

This research explored how these new spatial methodologies hold great potential for advancing ownership principles for IAOs in Malawi and throughout Africa due to their ability to treat knowledge as ever-partial, inherently situated, and never separate from the decisions researchers make as they gather, analyze, interpret, and represent information (Kemper, 2014).

Research Context

Addressing capacity constraints through school construction has long been a tradition of IAOs in Africa (Samoff, 1999; Bizhan, 2016). The 2016 IAO SEED grant is one example of a multi-million-dollar school construction project in this tradition. The Government of Malawi, in accepting SEED funding from IAO, also agreed to eliminate secondary school attendance fees nationwide and immediately hire 10,000 trained teachers (IAO, 2018). SEED sites were selected

primarily based on school performance on the PSLCE. The Primary School Leaving Certificate Examination (PSLCE) is the single test that will determine if a Malawian can enroll in secondary school—all eight years of prior learning are linked to this high-stakes test that students are required to pass in order to advance to the next level of schooling.

Using performance studies as a theoretical lens it is possible to see how a lack of ownership principles in international aid can lead to the current role play of powerful versus powerless that benefits bureaucrats over the ultra- and extremely poor. No matter the motivation for international aid, the only way for recipient nations to access the social and political gains that education systems are purported to offer is through sincere ownership by local citizens and governments.

Schools exist in communities, and deciding how and where to build a school holds the power to shape generations of young people. School construction by international aid organizations offers one powerful opportunity for increasing ownership opportunities in aid. The population in Africa is expected to be the world's fastest growing, and global definitions of the right to education have expanded in recent years to include free and compulsory secondary education. Under the influence of these crucial factors, the number of students enrolling in secondary schools in Africa will expand throughout the next decade.

In a resource-strapped environment such as Malawi, new school construction is an expensive undertaking that will continue to be shared by both the Government of Malawi and International Aid Organizations. When aid organizations construct new schools in countries where the governments have been politically unwilling or financially unable to do so, they hold a tremendous amount of negotiating power in deciding which communities will benefit from new

schools. Input from the local government or communities themselves is often optional, if considered at all.

This mixed-methods research has explored opportunities for increasing local ownership of international aid by examining the SEED program at the design, exploration, and implementation phases. The research was guided by the question of how Geographic Information Systems (GIS)-generated sites compare with manually selected sites for new school construction in terms of existing opportunities for ownership and how GIS or manual methods might expand opportunities for local ownership in future school construction projects. In analyzing practices and processes in international aid to education this research utilizes qualitative traditions in MMGIS that include disrupting hegemonic practices through storytelling and "muddying the boundaries [of] the mixing of methods" with techno-positionality.

Overall, the lack of analysis of the school site selection process in Malawi suggests a gap in the existing research that can be filled to improve the level of interaction between MOEST and development partners when selecting sites for construction. The analytical techniques in the manual and GIS cases were meant to stimulate realities for IAOs operating in Malawi in order to provide realistic policy recommendations. Yet a number of data concerns were noted, including spelling inconsistencies due to language differences; dramatic reductions in class size as student's progressed from standards seven to eight; unexplained missing scores from full primary schools; statistically impossible data that reflected more students passing than were tested; and schools that were missing from maps but had reported test score data.

Case Results

This in-depth look at Phase II of SEED through both qualitative and quantitative lenses was intended to provide critical insight towards future policy and practices. IAO determined the

ideal criteria for deciding where a school should be built. The decisions on site selection were based on a single year's test score data, the number of total and female students successfully passing the Primary School Leaving Certificate Exam, the overall pass rate of the school, and the capacity of the existing secondary schools to meet the needs of successful primary school students.

First, the manual practices used to generate sites for new school construction were examined to understand the principles and methodologies behind their development and how they matched the local context in Malawi. Second, GIS methods were used to visualize the same data in order to identify opportunities for local government inclusions and alternative methods for site selection.

Early in the data analysis it became abundantly apparent that IAO criteria were not well-suited for the data. The number of cases matching the criteria were well below the goals for new school construction. In Chapter 5, I describe national statistics, differentiate between the selected and non-selected groups, present correlations, and provide both linear and multilevel regression data models for the manual case study. I then outline how the early use of spatial analysis could have influenced IAO to identify district-specific instead of nation-wide selection criteria. Within the GIS case, I present the spatial analysis results showing data clustering, low/high score hotspots, and geographic regression. I conclude Chapter 5 with a presentation of "best fit sites" using location allocation in the Kasungu district as a demonstration for how future iterations of site selection could be approached. Kasungu district was selected due to its large size, high population, geographic diversity, and my own familiarity with the district.

Examination of the manual case revealed that inputs for site selection were largely based on the human capitalist view of education: the IAO criteria assumed the test scores were valid

indicators of a good fit for new secondary schools, but neither regression analysis nor multi-level modeling agreed. Indeed, the restrictive selection criteria that sought to benefit rural communities were unfortunately better suited for urban communities. While test score data was easy for IAO to obtain and analyze, regression analysis suggests that the national criteria used to analyze this data was too broad to be relevant at the school level.

As a simulation of ownership input and in seeking to expand the IAO model, this research simulated three additional criteria based on Malawian-collected and -reported data: the ratio of student to qualified teachers, ratio of students to permanent classrooms, and the standard seven to standard eight promotion rate. The inclusion of these data points did little to explain the key outcome of test scores. Still, the district-level indicators on ratio of quality teachers, permanent classrooms, and promotion rates provided for a more comprehensive model for understanding test score data.

The unexpected results of the IAO and IAO/MOEST combined regression models also make it clear that the IAO practice of setting criteria at the national level for site selection in individual communities is an ill-fitting model. There is simply too much variation within districts for one set of criteria to properly assess them all. If IAO is determined to use test score data as the ultimate indicator of student success, then district-, zonal-, and community-based criteria would likely be better suited to explain the variation in the data.

Ownership principles were largely non-existent in the actual practice of implementing the manual case. The time-consuming practice of manual calculations left little space for involving MOEST officials throughout the process and ultimately diminished ownership opportunities for Malawians to be involved in deciding where new schools could and should be constructed. Indeed, IAO used resources and time exploring questions in isolation that MOEST could have

easily provided quick answers to. For example, hours spent doing assessments of potential sites in person could have been saved by using the data MOEST had already collected on the availability of water and electricity at all schools. In practice, the manual methods were time-intense, isolated processes that made interactions with MOEST more superficial than exploratory and inclusive in nature.

Conclusions of Side-by-Side Comparison

Using GIS methodology, the second case explored how IAO could use the same test score data from the manual case to create district- and zonal-level distinctions for future policy. Rather than set one selection method for the nation, data visualization will allow IAO to differentiate between high and low areas of need in geographically diverse areas. Using geospatial techniques to display the criteria used for site selection, it became abundantly apparent why the regression model for the manual case did little to explain differences in data, nation-wide: the variation was too much for a national set of criteria to explain.

In terms of ownership principles, the inclusion of even simulated input by the government of Malawi in geospatial analysis offered multiple areas for government input. Instead of simply stating a desire to identify rural schools, GIS methods targeted a rural zone of 3-5 kilometers from existing schools and major roads—a far different number than the IAO-identified ten kilometers. Here too, input from MOEST could provide crucial, time-saving inputs such as sites that are already under development from other organizations or communities that may have mediating factors. Analysis that includes this informal data as well as linked to the EMIS system of indicators on teacher behaviors, student well-being, and community inputs can provide a more comprehensive set of criteria for determining where new schools should be built

beyond test score data. Yet inclusion of the EMIS system will require MOEST involvement at every step of the project.

Ultimately, the GIS case presented entirely different sites for new construction than the manual methods yielded, but the school profiles were strikingly similar. The crucial differences between the two cases were the different time inputs and the clear need for local input in GIS methods. While statistical analysis on test score data can be completed by anyone, visualizing a nation and its school system requires more local knowledge and offers greater opportunities for input from the Government of Malawi. The GIS case presented in this research included pre-obtained IAO data. In the future, a serious partnership between IAO and MOEST could use new GIS methodologies to incorporate the large amounts of EMIS data annually collected for more precise analysis. Such a partnership between IAO and MOEST could mean future sites are easily selected with zonal-level criteria that include other teacher-, student-, and school-level data.

Instead of making decisions based on a single IAO employee's capacity to analyze a dataset, GIS allows for the input of multiple datasets that can be analyzed in conversation and differentiated at the district and zonal levels. Of the two cases, the GIS case offered the clearest opportunities for ownership and input from the Government of Malawi, yet the immediate need for schools in many areas of Malawi was present in both cases. Despite the extraordinarily high levels of need in these areas, the "put it anywhere" mindset should not persist. If targeted gains are to be made in advancing the promises of national education systems, then criteria for new site selection should be made in partnership with local governments and communities. The collaborative process cannot begin at the time of construction but should occur throughout the site selection process.

Recommendations

My initial recommendation is based on a theme throughout this paper—future analysis must include a diverse team from both IAO and MOEST that operates in partnership and conversation instead of an individual with limited contextual knowledge.

Additionally, Future research in this vein should seek to find what criteria the Government of Malawi and Malawians view as crucial for optimal site location. Spatial displays of ideal qualitative measures could identify sites that are well-suited on multiple fronts to support new school environments, not those based on test scores alone. Indeed, integration of GIS analysis in the EMIS system could be a powerful use of existing technology by both IAO and MOEST. This integrated system could harness the output of annual data collection to create reports that are actionable and digestible for both MOEST administrators and IAOs without significantly increasing budgets, monitoring, or administrative activity. Additionally, practical considerations for population density and land scope should be considered in the model.

I designed my location allocations query for maximized locations with no capacity cap due to the nature of shift schools and classroom overcrowding; however future research should consider the addition of population weights and density when calculating maximized coverage. Also, additional possibilities within location allocation should be considered.

Finally, IAOs are not the only aid organizations that would benefit from knowledge on where resources are most needed in the expanding secondary school environment. Future consideration for making hot spot and data clustering publicly available could allow researchers, religious, and non-profit organizations to better target programming and funding.

Due to the high associated costs, wide-ranging social and economic impacts, and increasing capacity needs in building school buildings, new school construction and methods for selecting school construction sites have real-world implications for future aid and development practices

in Africa. Utilizing Geographic Information Systems to assist in future site selections, and to analyze how GOM, MOEST, and IAOs can work together to ensure more significant principles of ownership in school construction projects are timely, pragmatic questions that can immediately shape international aid to education for stronger outcomes.

APPENDIX A: DEFINITION OF KEY TERMS

Umuntu ngumuntu ngabantu —The concept of Ubuntu refers to the spirit of community and interdependence that has been attributed as an "African" philosophy (Regine, 2009). Along with performance studies, I take up Pan-African roots, which understand wisdom, humility, and generosity as far more essential to work on the African continent than validity and generalizability (Tate, 2004; Okeke & Van Wyk, 2016). Ubuntu, is a philosophy that follows the principle of umuntu ngumuntu ngabantu roughly meaning "a person is a person because of other people," "a person depends on others to be a person," or "I am because we are; and since we are, therefore I am" (Letseka, 2013). My overarching goal is to bring a positive naïveness to the table that enables me to learn and represent the many things I do not know with integrity and conviction (Madison, 2005).

Hip-Hop Affect Aesthetic— A self-coined term reflecting on the crucial influence of music on my journey in Malawi. My writing below is only one dimension of what I did and who I am, to tell the whole story would be impossible, and words alone could never do it justice. This term is generated from my solo-study of new trajectories in hip-hop imaginations and methodologies by Spence (2011), Dimitriadis (2015), Tate (2004), Perry (2004), Foreman & Anthony Neal (2012), Wilson (2010), Stovall (2006), Petchauer (2009), and Lindsey (2015).

"I recall the over-whelming sensation that what I was listening to in hip hop was as important and as valuable as anything I was being taught in school… valuing written traditions to the exclusion of oral ones unfairly marginalized the cultural productions of Africans and African Americans" (Dimitriadis, 2015, p.35). Hip-hop affect aesthetic emphasizes that there is more to this story than what you see on these pages, and all that is cannot be represented through the written word alone.

Post-positivist—This theoretical stance is the understanding that all research is influenced by the background, beliefs, and knowledge of researchers; there is no such thing as absolute truth (Panhwar, Ansari, & Shah, 2017).

International aid organizations—(IAO/s) There are many names for the organizations that spawned from the Bretton Woods conference: development partners; bi/multilateral organizations; donor nations; the west; global north nations; developed countries; first world nations (Moss, 2011). Throughout this proposal, I use International Aid Organization (IAO/s) to refer to the specific organization I spent time with as well as the aid industry as a whole.

MDG/SDG—Millennium Development Goals were eight time-bound goals for ending world poverty established by the United Nations in 2000. Upon expiration in 2015, the Sustainable Development Goals (SDGs) were established. The 17 SDGs aim to end world poverty by 2030.

SWAPS— Sector Wide Approaches (SWAPs) are vehicles for delivering aid money that brings together aid organizations, local governments, and other partners for distribution. SWAPs were designed to address criticism that IAOs were project focused and that aid ignored support industries.

MOEST—The Ministry of Education, Science, and Technology is the Government of Malawi's authority on public education in Malawi. I use MOEST in reference to two impressions I carry. First, MOEST as the "institution", established for me through the narratives of coworkers at IAO and research from others work about education in Malawi (Altbach, Arnove, & Kelly, 1982; Chakwera, Khembo, & Sireci, 2004; Englund, 2006; Kadzamira & Rose, 2003; Kendall, 2005). The previously listed research also influences my understandings of the Government of

Malawi (GOM). MOEST is also in reference to the team of individuals I interacted with while selecting and assessing sites for school construction with SEED.

Critical GIS/Mixed Methods GIS/Qualitative GIS — "Revolves around the variety of resonances and tensions to be explored, rather than resolved. One tension revolves around how the spatial and digital function in relation to issues of social justice…Critical GIS is not a historical body of scholarship but a set of living, diverse, dynamic endeavors necessary in the present and invested in transforming the future (Thatcher et al, 2016, p. 817).

"Although limited in number, [MMGIS] illustrate new ways of conducting education policy research. Epistemologically, they are grounded in critical, transformative, hybrid, pragmatic, and heterogeneous constructivism and other emergent research paradigms that emphasize knowing through multiple methodologies…They are built on the traditions that knowing and understanding our space and place emerge through multiple ways and sources." (Yoon, Gulson, & Libineski, 2018 p. 4)

IAO Criteria—Six parameters were defined by IAO as indicating an ideal site for new school construction. These criteria were based largely on student and school performance on a high-stakes test administered annually in July, the Primary School Leaving Certificate Exam. Primary school students are not eligible to advance to secondary schools without successfully passing this exam.

1. >10km from a main road
2. >10km from an existing secondary school
3. >n=50 total students passing PSLCE
4. >n=25 girls passing PSLCE
5. >75% PSLCE pass rate.

6. Located in a zone with a low zonal catering rate.

Moran's I—Moran's Index is one of the most common cross-product statistical techniques used in geographic analysis (Chen, 2013; Fischer & Wang, 2011, Lee & Li, 2017). Moran's I was developed in the 1940's and uses a correlation matrix to determine if values are normally or randomly distributed (Yamada & Okabe, 2015, Souris & Bichaud, 2011, Fischer & Wang, 2011). In ArcGis, Moran's I tool is an analytic technique that generates a z-score to assess whether data is clustered, dispersed, or random. If the z-score is statistically significant and the Moran's I value is positive then spatial clustering exists, a negative value indicates dispersion.

Getis-Ord Gi* Statistic— Getis-Ord Gi* Statistic is the statistical formula at the base of mathematical calculations for hotspot analysis, in GIS research it is used to identify significant clusters of high and low values (Ansong, Ansong, Ampomah, & Afranie, 2015; Ansong, Chowa, & Adabeng, 2015; Defar, Okwaraji, Tigabu, Persson, Alemu, 2019). Complimenting the Moran's I tool, Getis-Ord General analysis can validate the existence of spatial patterns and data clustering. Getis-Ord Gi* asks of the data, "What are the chances that high and low scores are randomly grouped?" by identifying a neighborhood (zone of secondary school), within a study area (district) of the population (Malawi) (ESRI, 2011). In Arc-GIS, Getis-Ord Gi* returns data that identifies a neighborhood as hot (higher than study area), cold (lower than the area), or not significant (random average of the area) at ninety, ninety-five, and ninety-nine percent confident levels (Gwitira, Murwire, Zengeya, Shekede, 2018).

Geographically Weighted Regression—Geographically Weighted Regression builds on the concepts of linear regression, line of best fit, and ordinary least squares. Instead of using linear distance to calculate the least squares line of best fit, geographically weighted regression uses spatial distance to identify statistically significant clusters of high and low values in GIS

data (ESRI, 2011). Instead of identifying similar scores or cases, Geographically Weighted Regression measures extreme homogeneity in spaces that are close in proximity (Ansong, Ampomah, Adjabeng, 2015). Geographically weighted regression is a nonparametric, local regression based on a moving weighted average; the further away from a linear regression an item is, the less weight it is given in analysis, and all data points must add up to one.

Kernel Density analysis—Kernel Density Analysis is a "sophisticated way to model the spread of services across a landscape, making it possible to assess whether [schools] are available to all populations (Ansong, 2014). Kernel Density Analysis that accounts for the curvature of the earth's surface use geodesic measures instead of planar distances.

Location Allocation—Location Allocation is a spatial technique used to identify optimal sites for placing new structures based on existing structures and populations of need. While the technique dates decades, ArcGIS Pro offers a toolbox that uses spatial analysis to allocate the ideal locations to build service centers (secondary schools) based on the existing locations of demand populations (primary schools), offering a list of ideal sites based on user inputted data (Vora, Yasobant, Sengupta, De Costa, Upadhyay, & Mavalankar, 2015).

APPENDIX B: IRB EXEMPTION

From: **IRB** no_reply@unc.edu
Subject: IRB Notice - 19-2626
Date: November 21, 2019 at 10:09 AM
To: xrong@email.unc.edu, ogjs@live.unc.edu

To: Olivia Scott and Xue Rong
School of Education

From: Office of Human Research Ethics

Date: 11/21/2019
RE: Notice of IRB Exemption
Exemption Category: 4. Secondary data/specimens
Study #: 19-2626

Study Title: Geographic Information Systems (GIS) & Ownership on International Aid to Education in Malawi

This submission, Reference ID 260286, has been reviewed by the Office of Human Research Ethics and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.104.

Study Description:

Purpose: School construction remains a crucial tool for international aid organizations (IAOs) which seek to eliminate barriers to economic growth and educational attainment in Malawi and throughout Africa (Moss, 2011; Sperling & Winthrop, 2015). The process of selecting sites for new school construction is a difficult task for IAOs because of their need to select sites using methods that are as "impartial", "equitable", and "data-driven" as possible (Mawdsley, 2017). As such, the selection process can be lengthy, siloed, and feature limited involvement from the Government of Malawi (Collins, 2011). Ultimately, the school construction site selection process can undermine IAOs efforts at increasing ownership of foreign aid projects by the Government of Malawi (Chirwa, 2012; Bizhan, 2016).

Participants: Using the authors experience living and working in Malawi and Mixed Methods Geographic Information Systems (GIS), the study will analyze publicly available quantitative data provided by the Malawian Ministry of Education, Science, and Technology (MOEST) and the United States Agency for International Development (USAID) to identify optimal sites for new school construction

Procedures (methods): Processing will be completed using ArcGIS and an Analytical Hierarchy Process (AHP) for the data which will be ranked according to a Multi-Criteria Decision Analyst method (HaryPrasetyo, Muhamad, & Fauzi, 2016). The results will be compared with manually-generated site selections in order to identify opportunities for change and partnership in selecting future school construction sites.

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes. There is no need to inform the IRB about changes in study personnel. However, be aware that you are responsible for ensuring that all members of the research team who interact with subjects or their identifiable data complete the required human subjects training, typically completing the relevant CITI modules.

The IRB will maintain records for this study for 3 years, at which time you will be contacted about the status of the study.

The current data security level determination is Level I. Any changes in the data security level need to be discussed with the relevant IT official. If data security level II and III, consult with your IT official to develop a data security plan. Data security is ultimately the responsibility of the Principal Investigator.

Please be aware that approval may still be required from other relevant authorities or "gatekeepers" (e.g., school principals, facility directors, custodians of records), even though the project has determined to be exempt. .
IRB Informational Message - please do not use email REPLY to this address

APPENDIX C: PUBLIC SCHOOLS PSLCE

PSLCE FOR PUBLIC PRIMARY SCHOOLS FOR 2016

Division	District	Zone	school_nam	Sat		Passed	
				Boys	Girls	Boys	Girls
Central Eastern	Dowa	Chigudu	Mkanga School	35	31	29	29
Central Eastern	Dowa	Chigudu	Mpatawadzombe School	31	26	30	24
Central Eastern	Dowa	Chigudu	Msambaimfa School	0	0	0	0
Central Eastern	Dowa	Chigudu	Mtethera School	12	7	11	7
Central Eastern	Dowa	Chigudu	Mwangala School	50	36	48	33
Central Eastern	Dowa	Chigudu	Nakondwa LEA School	13	14	0	6
Central Eastern	Dowa	Chigudu	Thedze School	9	20	9	20
Central Eastern	Dowa	Chimbuli	Bowe School	75	42	56	19
Central Eastern	Dowa	Chimbuli	Chikhobwe School	46	31	35	24
Central Eastern	Dowa	Chimbuli	Chilinde	0	0	0	0
Central Eastern	Dowa	Chimbuli	Chimbuli School	27	15	25	13
Central Eastern	Dowa	Chimbuli	Chimkoka School	54	42	38	39
Central Eastern	Dowa	Chimbuli	Chinkhwiri LEA School	51	43	45	43
Central Eastern	Dowa	Chimbuli	Chiwichiwi School	25	20	25	14
Central Eastern	Dowa	Chimbuli	Dzalo FP School	12	11	11	11
Central Eastern	Dowa	Chimbuli	Gudyu School	26	24	22	21

APPENDIX D: SECONDARY SCHOOL ENROLMENT SAMPLE

Public Secondary Schools Enrolment by form for 2016

Division	District	Cluster	school	Form 1		Form 2		Form 3		Form 4		Total	
				Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Northern	Chitipa	Wenya Sec School	Mibanga CDSS	22	22	23	30	0	0	0	0	**45**	**52**
Northern	Chitipa	Wenya Sec School	Therere CDSS	25	13	19	14	21	7	23	7	**88**	**41**
Northern	Chitipa	Wenya Sec School	Kapirinkhonde CDSS	26	24	35	26	15	8	13	10	**89**	**68**
Northern	Chitipa	Wenya Sec School	Wenya Secondary School	50	50	45	48	40	50	49	44	**184**	**192**
Northern	Chitipa	Wenya Sec School	Chisenga Open	8	7	26	18	3	6	5	15	**42**	**46**
Northern	Chitipa	Wenya Sec School	Nthalire Open	45	30	41	39	27	19	53	47	**166**	**135**
Northern	Chitipa	Wenya Sec School	Wenya Open	2	1	4	11	10	5	18	10	**34**	**27**
Northern	Karonga	Chilumba Sec.	Khwawa	45	42	29	24	26	70	105	28	**205**	**164**
Northern	Karonga	Chilumba Sec.	Mlare	49	45	52	43	46	45	56	46	**203**	**179**
Northern	Karonga	Chilumba Sec.	Fulirwa	18	20	17	15	5	12	13	6	**53**	**53**
Northern	Karonga	Chilumba Sec.	Tirola	23	21	20	16	16	8	29	14	**88**	**59**
Northern	Karonga	Chilumba Sec.	Ngara	23	23	15	14	12	8	12	8	**62**	**53**
Northern	Karonga	Chilumba Sec.	Nyungwe	38	46	32	48	24	36	30	46	**124**	**176**
Northern	Karonga	Chilumba Sec.	Chilumba	47	31	62	52	83	27	66	38	**258**	**148**
Northern	Karonga	Chilumba Sec.	Chilumba Open secondary School	50	35	72	38	49	29	134	105	**305**	**207**
Northern	Karonga	Chilumba Sec.	St Anns	25	25	25	25	25	24	25	25	**100**	**99**
Northern	Karonga	Chilumba Sec.	Thunduti CDSS	22	21	25	23	15	18	31	15	**93**	**77**
Northern	Karonga	Chilumba Sec.	Khwawa CDSS Open	53	28	60	38	23	13	34	33	**170**	**112**
Northern	Karonga	Chilumba Sec.	Thunduti Open	23	14	27	18	18	12	16	9	**84**	**53**
Northern	Karonga	Chilumba Sec.	Nyungwe Open	11	8	9	13	19	13	21	6	**60**	**40**
Northern	Karonga	Chilumba Sec.	Mlare Open	32	13	41	27	23	16	40	31	**136**	**87**
Northern	Karonga	Chilumba Sec.	Tilora Open	11	8	33	19	17	3	18	17	**79**	**47**
Northern	Karonga	Chilumba Sec.	St Annes Open	30	28	25	6	33	34	19	32	**107**	**100**
Northern	Karonga	Karonga CDSS	Karonga CDSS	95	103	95	102	44	40	86	90	**320**	**335**
Northern	Karonga	Karonga CDSS	Karonga Girls	0	82	0	90	0	95	0	88	**0**	**355**
Northern	Karonga	Karonga CDSS	Chaminade	136	0	137	0	119	0	89	0	**481**	**0**

APPENDIX E: FEEDER SCHOOLS FOR ALL SECONDARY SCHOOLS

B. DISTRICT DAY SECONDARY SCHOOL

NKHOTAKOTA

SERIAL NO.	NAME OF SECONDARY SCHOOL	CAPACITY BOYS	CAPACITY GIRLS	CAPACITY TOTAL	FEEDER SCHOOL NAME	PRIMARY SCHOOL CENTRE #
1	WALEMERA SEC SCHOOL	50	50	100		
					CHIZEWO	12
					KALINDA	19
					WALEMERA	55
					CHAMBWANDE	66
					MATUMBI	73
					MPANDAWADOTHI	86
					MSANGU	97
					MDYANKHANGA	132
2	MWANSAMBO SEC SCHO	50	50	100		
					KASANGADZI	23
					LIUDZI	30
					NAMBALE	82
					KASIYA	105
3	LOZI SEC SCHOOL	50	50	100		
					CHOMBO	13
					LOZI	32
					MNDULUKA	43
					MWALAWATONGOLE	63
					CHANTHOMBA	114
					MTANDIRA	121
					KANYENJE	128

KASUNGU

	NAME OF SECONDARY SC	CAPACITY BOYS	CAPACITY GIRLS	CAPACITY TOTAL	FEEDER SCHOOLS NAME	PRIMARY SCHOOL CODE NUMBER
	SANTHE SEC SCHOOL	50	50	100	Chaima	2
					Chigandwa	18
					Kamtimbo	54
					Kasanduliza	61
					Kawata	71
					Mgumira	88
					Mkhota	92
					Mtoso	96

APPENDIX F: IDENTIFIED SITES FOR MACHINGA DISTRICT

CHIKWAWA DISTRICT SUGGESTED SCHOOL SITES

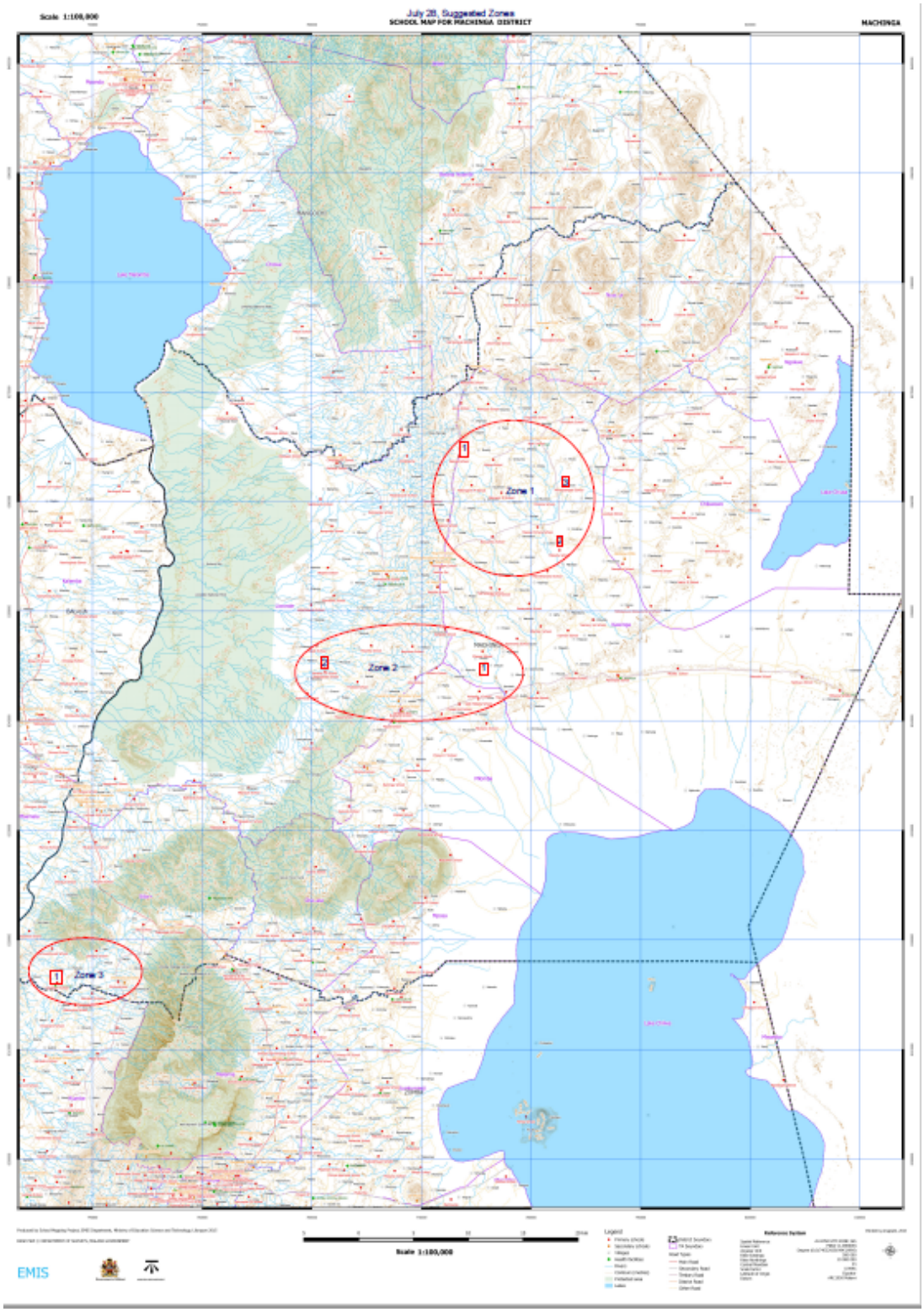
SN	Current Sec. School	Current Intake			Feeder Schools							
						Standard 8 Enrolment			Pass Rate				
		Male	Female	Total	Name of School	Male	Female	Total	Male	Female	Total	%	Remarks
14	Chapananga S S	50	50	100	Kubalalika	22	19	41	15	1	16	39%	
					Phwadzi	79	27	106	71	24	95	90%	
					Lundu	39	9	48	13	7	20	42%	
					Tchande	16	8	24	15	7	22	92%	
					Gungulu	33	8	41	32	7	39	95%	
					Mwanaalirenji	20	7	27	15	2	17	63%	
					Namiwawa	7	3	10	3	1	4	40%	
					Tetera	32	18	50	31	15	46	92%	
	Sub Total					**327**	**137**	464	**257**	**89**	346	75%	**Secondary school caters for 28.9% of those who passed**
15	Nkumaniza CDSS	50	50	100	Nkumaniza	58	25	83	40	12	52	63%	
					Mwala	33	8	41	12	2	14	34%	
					Therere	44	44	88	29	9	38	43%	
					Saindi	23	19	42	15	10	25	60%	
					Nsenjere	36	11	47	21	3	24	51%	
					Nsinja	56	34	90	26	14	40	44%	Therere next to Chidimba (15/54%)
					Chituwi	18	10	28	8	3	11	39%	
					Nachipere	11	12	23	3	6	9	39%	
					Chidimba	20	8	28	13	2	15	54%	
					Nabisi	24	15	39	11	2	13	33%	
	Sub Total					**323**	**186**	509	**178**	**63**	241	47%	**Secondary school caters for 41.5% of those who passed**
16	Mbiya CDSS	25	25	50	Mbiya	48	22	70	44	20	64	91%	
					Thendo	25	5	30	22	2	24	80%	
					Dolo	68	20	88	62	16	78	89%	
					Chidyamanga	54	19	73	27	15	42	58%	
					Masanduko	26	7	33	11	1	12	36%	
					John	22	3	25	9	0	9	36%	
					Chindole	24	20	44	19	20	39	89%	
													Secondary school caters for 18.7% of

APPENDIX G: MOEST REPORT FOR MZIMBA SOUTH DISTRICT

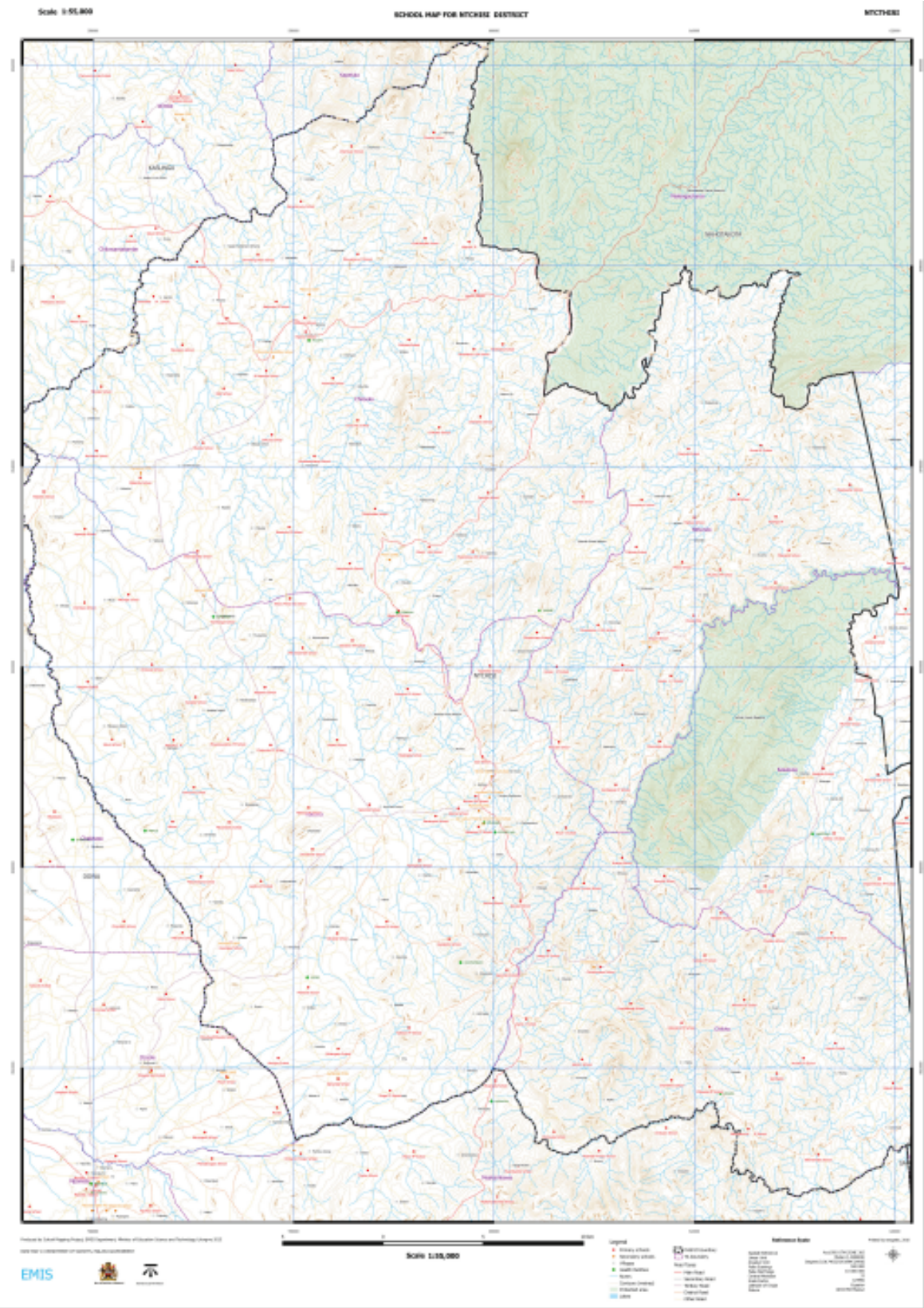
Mzimba South Proposed Building Sites

Zone	School Site	Notes
Zone 1	Mtuza	
	Chasato	
Zone 2	Kamwamphimbi	
	Lupuha	
Zone 3	Thoza	
	Kalungulu	
Zone 4	Machamila	
	Mkonje	
Zone 5	Chamaji	
	Mgoza	
Alternatives	**Zone 1**	Thundwe, Kalweya
	Zone 2	Watereka, Machelechete, Kabuku
	Zone 3	Kachenyu
	Zone 4	Mjinge, Makazi, Chanjovu, Tchesa
	Zone 5	Tupwenge, Moyoko,

APPENDIX H: MAP OF IDENTIFIED STIES FOR MACHINGA DISTRICT



APPENDIX I: EXAMPLE OF IAO MAP, NTCHISI DISTRICT



APPENDIX J: GREATER THAN 50 STUDENTS PASSING BY DISTRICT

District	Total passed PSLCE
Lilongwe City	150
Thyolo	112
Blantyre City	110
Mulanje	81
Chiradzulu	62
Ntcheu	59
Phalombe	57
Lilongwe Rural West	57
Dowa	56
Kasungu	49
Zomba Rural	45
Mchinji	43
Karonga	43
Blantyre Rural	42
Chikwawa	40
Mzuzu City	40
Dedza	37
Lilongwe Rural East	36
Balaka	30
Salima	29
Machinga	27
Mangochi	24
Zomba Urban	24
Mzimba South	24
Nsanje	19
Ntchisi	19
Nkhotakota	17
Mzimba North	16
Neno	15
Chitipa	12
Mwanza	10
Rumphi	10
Nkhata Bay	8
Total	1403

APPENDIX K: DISTRICT SUMMARY OF SITES WITH 50 TOTAL STUDENTS AND 25 GIRLS

District	N	Mean	% of Total N
Lilongwe City	141	84.82%	13.7%
Blantyre City	99	68.97%	9.6%
Thyolo	86	82.67%	8.4%
Mulanje	60	89.18%	5.8%
Ntcheu	46	84.60%	4.5%
Lilongwe Rural West	44	89.70%	4.3%
Chiradzulu	43	74.83%	4.2%
Mzuzu City	40	85.04%	3.9%
Dowa	37	84.10%	3.6%
Kasungu	31	79.58%	3.0%
Blantyre Rural	30	66.85%	2.9%
Phalombe	29	77.78%	2.8%
Lilongwe Rural East	28	74.59%	2.7%
Karonga	28	63.92%	2.7%
Mchinji	26	79.02%	2.5%
Zomba Rural	26	73.73%	2.5%
Balaka	25	80.52%	2.4%
Mzimba South	22	74.47%	2.1%
Dedza	19	75.58%	1.8%
Zomba Urban	18	83.86%	1.8%
Mangochi	18	84.73%	1.8%
Machinga	18	67.47%	1.8%
Salima	18	75.94%	1.8%
Chikwawa	16	65.37%	1.6%
Ntchisi	13	82.97%	1.3%
Nkhotakota	13	65.70%	1.3%
Mzimba North	12	68.69%	1.2%
Neno	10	71.42%	1.0%
Chitipa	9	69.82%	0.9%
Nsanje	8	78.42%	0.8%
Rumphi	6	80.50%	0.6%
Nkhata Bay	6	70.11%	0.6%
Mwanza	3	89.31%	0.3%
Total	1028	78.84%	100.0%

APPENDIX L: SITES WITH 50 TOTAL, 25 FEMALE, 75% PASS RATE

District	Percent Total Passed
Lilongwe City	123
Thyolo	74
Mulanje	56
Blantyre City	46
Ntcheu	43
Lilongwe Rural West	43
Dowa	35
Mzuzu City	34
Chiradzulu	31
Phalombe	25
Balaka	20
Kasungu	20
Zomba Rural	18
Salima	16
Mchinji	14
Zomba Urban	14
Mangochi	13
Dedza	12
Lilongwe Rural East	12
Mzimba South	12
Ntchisi	11
Blantyre Rural	11
Machinga	10
Karonga	10
Chikwawa	8
Rumphi	6
Nsanje	6
Mzimba North	6
Nkhotakota	6
Chitipa	5
Neno	5
Nkhata Bay	3
Mwanza	3
TOTAL	751

APPENDIX M: SITES WITH 50 TOTAL, 25 FEMALE, >75% PASS RATE, & LOW CATERING RATE

District	Zonal Catering Rate
Lilongwe City	121
Thyolo	67
Mulanje	56
Blantyre City	41
Lilongwe Rural West	37
Mzuzu City	34
Dowa	30
Chiradzulu	29
Ntcheu	29
Phalombe	25
Kasungu	18
Balaka	18
Zomba Rural	16
Salima	15
Mchinji	14
Lilongwe Rural East	10
Mangochi	9
Dedza	8
Karonga	8
Mzimba South	7
Zomba Urban	7
Ntchisi	7
Nkhotakota	6
Blantyre Rural	6
Chikwawa	6
Rumphi	5
Nsanje	5
Chitipa	5
Machinga	4
Neno	4
Mwanza	3
Mzimba North	2
Nkhata Bay	1
Total	653

APPENDIX N: TOTAL STUDENTS PASSING FOR SELECTED SITES

Selected Sites

Total passed PSLCE

District	N	Mean	Minimum	Maximum	Variance	Std. Deviation
Lilongwe City	10	178	82	331	5082.056	71.289
Mzuzu City	12	176	92	351	5613.659	74.924
Blantyre City	10	154	51	317	8077.733	89.876
Zomba Urban	10	111	50	197	2843.389	53.323
Thyolo	10	87	40	187	2421.511	49.209
Mulanje	9	80	41	123	737.611	27.159
Chiradzulu	12	62	45	92	227.970	15.099
Mchinji	10	59	48	75	68.989	8.306
Zomba Rural	10	56	41	71	91.567	9.569
Dedza	10	55	40	91	268.222	16.377
Mangochi	10	55	26	99	547.122	23.391
Kasungu	12	55	33	84	195.902	13.996
Phalombe	11	52	23	91	423.364	20.576
Balaka	9	51	32	92	512.611	22.641
Nsanje	11	51	14	104	666.218	25.811
Nkhotakota	10	51	26	135	1281.833	35.803
Neno	9	50	30	88	312.778	17.686
Dowa	9	49	30	87	280.000	16.733
Ntchisi	10	49	34	101	407.344	20.183
Karonga	9	48	35	70	199.611	14.128
Chikwawa	10	45	24	78	277.211	16.650
Machinga	10	43	25	77	284.844	16.877
Salima	9	42	14	72	383.194	19.575
Ntcheu	10	41	24	59	157.778	12.561
Mzimba North	8	39	24	61	130.982	11.445
Mwanza	9	39	21	54	157.278	12.541
Mzimba South	10	38	16	69	262.678	16.207
Nkhata Bay	10	37	26	47	61.556	7.846
Chitipa	9	34	20	53	93.944	9.692
Blantyre Rural	10	34	12	64	342.622	18.510
Total	298	65	12	351	2587.964	50.872

APPENDIX O: TOTAL FEMALES PASSED FOR SELECTED SITES

Selected Sites

Females passed PSLCE

District	N	Mean	Minimum	Maximum	Variance	Std. Deviation
Lilongwe City	10	92	44	171	1452.722	38.115
Mzuzu City	12	91	36	202	1833.356	42.818
Blantyre City	10	71	25	168	2136.233	46.219
Zomba Urban	10	58	23	105	921.878	30.362
Thyolo	10	35	18	94	625.389	25.008
Mulanje	9	32	9	49	217.778	14.757
Chiradzulu	12	26	13	37	83.174	9.120
Balaka	9	24	13	41	88.500	9.407
Mchinji	10	23	15	30	25.789	5.078
Mzimba South	10	22	8	44	135.111	11.624
Neno	9	22	14	38	58.028	7.618
Dedza	10	21	11	30	45.067	6.713
Zomba Rural	10	21	9	32	47.878	6.919
Kasungu	12	21	8	36	104.061	10.201
Ntchisi	10	20	7	50	155.378	12.465
Dowa	9	19	7	45	140.000	11.832
Mangochi	10	18	7	36	101.067	10.053
Machinga	10	18	8	33	84.178	9.175
Blantyre Rural	10	18	3	38	146.667	12.111
Phalombe	11	18	10	36	66.855	8.176
Ntcheu	10	17	9	29	41.333	6.429
Karonga	9	17	9	28	50.694	7.120
Mzimba North	8	16	5	28	51.554	7.180
Chitipa	9	16	9	38	81.500	9.028
Nkhotakota	10	15	3	47	244.056	15.622
Salima	9	15	7	28	50.250	7.089
Nkhata Bay	10	15	6	27	46.233	6.800
Nsanje	11	14	1	30	63.091	7.943
Mwanza	9	13	5	23	37.000	6.083
Chikwawa	10	13	2	24	64.056	8.003
Total	298	28	1	202	761.424	27.594

APPENDIX P: OVERALL PASS RATES FOR SELECTED SITES

Selected Sites

Percent Total Passed

District	N	Mean	Minimum	Maximum	Variance	Std. Deviation
Mulanje	9	92.06%	72.22%	100.00%	112.3676	10.6004
Thyolo	10	90.26%	69.77%	100.00%	79.9286	8.9403
Ntchisi	10	88.89%	75.00%	100.00%	61.0754	7.8151
Lilongwe City	10	86.84%	73.23%	98.91%	82.6320	9.0902
Mzuzu City	12	85.77%	62.46%	99.30%	108.4388	10.4134
Zomba Urban	10	84.36%	63.16%	98.48%	117.5725	10.8431
Mangochi	10	84.05%	60.00%	100.00%	162.1870	12.7353
Mwanza	9	83.78%	57.14%	96.43%	173.3767	13.1673
Phalombe	11	83.51%	70.51%	96.97%	62.3674	7.8973
Balaka	9	83.38%	66.00%	94.12%	95.6633	9.7808
Mchinji	10	82.35%	65.22%	100.00%	148.7327	12.1956
Dowa	9	81.57%	58.51%	97.56%	138.1477	11.7536
Dedza	10	80.47%	65.28%	95.83%	86.4677	9.2988
Blantyre City	10	79.09%	61.54%	93.52%	81.9646	9.0534
Chiradzulu	12	79.02%	65.12%	88.10%	61.4250	7.8374
Mzimba North	8	78.87%	67.35%	97.96%	100.5373	10.0268
Ntcheu	10	78.74%	54.55%	95.35%	228.9270	15.1303
Mzimba South	10	78.49%	57.14%	90.91%	153.4459	12.3873
Salima	9	77.98%	46.67%	100.00%	343.7263	18.5399
Nsanje	11	77.38%	42.42%	100.00%	446.1029	21.1211
Chikwawa	10	76.88%	43.18%	100.00%	298.2231	17.2691
Kasungu	12	74.76%	60.71%	98.53%	175.8531	13.2610
Nkhotakota	10	73.25%	53.57%	95.12%	242.8575	15.5839
Karonga	9	73.21%	62.07%	88.31%	77.1159	8.7816
Neno	9	73.12%	37.86%	94.00%	322.4550	17.9570
Zomba Rural	10	71.75%	58.57%	81.61%	61.7497	7.8581
Machinga	10	69.61%	49.21%	84.21%	154.0869	12.4132
Nkhata Bay	10	69.42%	35.40%	100.00%	421.9082	20.5404
Chitipa	9	64.43%	42.55%	91.67%	231.6733	15.2208
Blantyre Rural	10	54.94%	30.00%	94.12%	516.5851	22.7285
Total	298	78.64%	30.00%	100.00%	219.3564	14.8107

APPENDIX Q: AVERAGE CATERING RATE FOR SELECTED SITES

Selected Sites
Zonal Catering Rate

District	N	Mean	Minimum	Maximum	Variance	Std. Deviation
Nkhata Bay	10	44.87%	28.25%	98.04%	585.8329	24.2040
Mzimba North	8	35.49%	19.23%	59.17%	258.0022	16.0624
Mwanza	9	34.67%	27.70%	54.95%	133.0277	11.5338
Mangochi	10	34.01%	22.39%	56.60%	114.6826	10.7090
Mzimba South	10	32.40%	20.92%	57.47%	137.9591	11.7456
Machinga	10	32.37%	22.03%	46.73%	75.5905	8.6943
Zomba Urban	10	31.93%	8.96%	53.48%	302.9273	17.4048
Kasungu	12	31.35%	15.63%	43.48%	95.2690	9.7606
Chitipa	9	31.20%	23.15%	49.26%	87.0909	9.3323
Nkhotakota	10	29.84%	21.19%	71.43%	247.5962	15.7352
Blantyre Rural	10	28.76%	17.76%	49.83%	164.8100	12.8378
Neno	9	28.16%	17.92%	43.67%	118.3707	10.8798
Dedza	10	27.48%	23.70%	36.10%	16.2407	4.0300
Ntcheu	10	26.55%	18.69%	52.08%	91.5113	9.5662
Zomba Rural	10	25.92%	19.31%	31.58%	15.1727	3.8952
Mzuzu City	12	25.48%	11.76%	35.46%	66.6949	8.1667
Nsanje	11	25.16%	19.77%	34.97%	29.6721	5.4472
Dowa	9	24.23%	15.38%	38.76%	61.0061	7.8106
Ntchisi	10	24.02%	14.88%	33.00%	55.9812	7.4821
Karonga	9	23.27%	10.27%	49.26%	150.1072	12.2518
Mchinji	10	22.34%	15.04%	39.68%	96.3980	9.8182
Balaka	9	22.22%	9.54%	31.78%	86.0039	9.2738
Salima	9	21.84%	14.48%	43.86%	94.7295	9.7329
Chikwawa	10	21.78%	13.87%	41.49%	67.6828	8.2270
Mulanje	9	19.99%	9.69%	34.97%	104.6975	10.2322
Chiradzulu	12	19.37%	14.37%	30.30%	26.9572	5.1920
Thyolo	10	16.19%	7.69%	26.56%	74.0013	8.6024
Lilongwe City	10	14.44%	5.18%	29.30%	64.0717	8.0045
Phalombe	11	14.16%	9.75%	24.10%	16.6991	4.0865
Blantyre City	10	13.26%	9.61%	16.05%	5.0487	2.2469
Total	298	25.98%	5.18%	98.04%	150.7229	12.2769

APPENDIX R: COMBINED LINEAR REGRESSION MODEL, FEMALE PASSRATE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	79.77	2.33		34.29	.000
	>50% District Cater	-16.57	1.35	-.2400	-12.32	.000
	40-50% District Cater	-4.47	1.25	-.0800	-3.58	.000
	30-40% District Cater	-.7920	1.28	-.0130	-.6200	.535
	80-100% Zone Cater	-4.32	2.14	-.0300	-2.02	.043
	60-80% Zone Cater	-9.73	1.66	-.0910	-5.88	.000
	40-60% Zone Cater	-4.78	1.17	-.0720	-4.08	.000
	20-40% Zone Cater	.6250	.9450	.0120	.6610	.508
	<75 Students per Class	-12.52	2.45	-.1120	-5.11	.000
	75-100 Students per Class	-11.09	2.01	-.1780	-5.53	.000
	100-125 Students per Class	-3.98	1.75	-.0700	-2.28	.023
	125-150 Students per Class	-.0160	1.80	.0000	-.0090	.993
	47-64 Students to Teacher	20.95	2.19	.1820	9.58	.000
	68-77 Students to Teacher	8.73	1.20	.1470	7.27	.000
	78-85 Students to Teacher	2.15	1.13	.0400	1.91	.057
	56-61% Promotion Rate	-8.40	1.73	-.1470	-4.87	.000
	63-71% Promotion Rate	-15.57	1.69	-.2860	-9.24	.000

a. Dependent Variable: Percent Females Passed

APPENDIX S: SIMULATED MOEST REGRESSION MODEL

Simulated MOEST Regression model with no controls

Coefficients[a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	63.132	1.229		51.370	.000
<75 Students per Classroom	-16.452	2.064	-.172	-7.970	.000
75-100 Students per Classroom	-13.950	1.679	-.263	-8.307	.000
100-125 Students per Classroom	-3.018	1.469	-.063	-2.055	.040
125-150 Students per Classroom	5.289	1.479	.108	3.575	.000
47-64 Students to Teacher	29.498	1.679	.303	17.565	.000
68-77 Students to Teacher	7.959	.994	.157	8.008	.000
78-85 Students to Teacher	5.902	.913	.127	6.468	.000
56-61% Promotion Rate	2.398	.772	.049	3.107	.002
<49% Promotion Rate	10.257	1.347	.116	7.613	.000

a. Dependent Variable: Percent Total Passed

Simulated MOEST Regression, controlled for Division

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	65.554	1.454		45.083	.000
	Division	-.751	.241	-.056	-3.109	.002
	<75 Students per Classroom	-14.013	2.207	-.146	-6.350	.000
	75-100 Students per Classroom	-12.365	1.754	-.233	-7.051	.000
	100-125 Students per Classroom	-2.996	1.468	-.062	-2.041	.041
	125-150 Students per Classroom	5.364	1.478	.109	3.629	.000
	47-64 Students to Teacher	29.579	1.678	.304	17.627	.000
	68-77 Students to Teacher	8.012	.993	.158	8.068	.000
	78-85 Students to Teacher	6.363	.924	.137	6.888	.000
	56-61% Promotion Rate	1.634	.809	.034	2.020	.043
	<49% Promotion Rate	10.441	1.347	.118	7.749	.000

a. Dependent Variable: Percent Total Passed

Simulated MOEST Regression, controlled for District

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	65.143	1.388		46.945	.000
	District	-.142	.046	-.057	-3.111	.002
	<75 Students per Classroom	-13.664	2.249	-.143	-6.077	.000
	75-100 Students per Classroom	-12.489	1.742	-.236	-7.168	.000
	100-125 Students per Classroom	-3.082	1.468	-.064	-2.100	.036
	125-150 Students per Classroom	5.430	1.479	.111	3.672	.000
	47-64 Students to Teacher	29.652	1.679	.305	17.665	.000
	68-77 Students to Teacher	8.151	.995	.161	8.193	.000
	78-85 Students to Teacher	6.459	.929	.139	6.952	.000
	56-61% Promotion Rate	1.708	.802	.035	2.129	.033
	<49% Promotion Rate	10.430	1.347	.118	7.742	.000

a. Dependent Variable: Percent Total Passed

APPENDIX T: DISTANCE TO ROADS BY DISTRICT, <10KM

Case Summaries

Distance to Major Roads

District	N	Mean	Minimum	Maximum	Variance	Std. Deviation
Thyolo	170	.0369	.00	.09	.001	.02466
Mwanza	21	.0363	.00	.09	.001	.02935
Dowa	192	.0362	.00	.09	.001	.02492
Mchinji	117	.0323	.00	.09	.001	.02613
Ntchisi	122	.0321	.00	.09	.001	.02406
Salima	113	.0299	.00	.09	.001	.02671
Lilongwe Rural East	130	.0296	.00	.09	.001	.02259
Dedza	167	.0288	.00	.09	.001	.02384
Mulanje	115	.0276	.00	.09	.001	.02315
Neno	42	.0275	.00	.08	.001	.02735
Blantyre Rural	144	.0269	.00	.08	.000	.01968
Zomba Rural	147	.0262	.00	.08	.000	.02086
Lilongwe Rural West	208	.0262	.00	.09	.000	.02155
Kasungu	288	.0258	.00	.09	.001	.02425
Mzimba North	199	.0258	.00	.09	.001	.02387
Balaka	121	.0257	.00	.09	.000	.02210
Mzimba South	194	.0255	.00	.09	.000	.02188
Nkhotakota	128	.0253	.00	.09	.001	.02280
Ntcheu	177	.0251	.00	.09	.001	.02244
Chikwawa	113	.0230	.00	.09	.001	.02432
Chiradzulu	88	.0227	.00	.07	.000	.01753
Mangochi	171	.0217	.00	.09	.001	.02386
Phalombe	103	.0214	.00	.07	.000	.01889
Nkhata Bay	124	.0206	.00	.09	.000	.02227
Machinga	112	.0202	.00	.08	.000	.01980
Blantyre City	134	.0169	.00	.04	.000	.01197
Nsanje	70	.0166	.00	.08	.000	.01986
Karonga	154	.0151	.00	.08	.000	.01657
Rumphi	127	.0140	.00	.09	.000	.01713
Chitipa	167	.0140	.00	.06	.000	.01341
Lilongwe City	179	.0138	.00	.08	.000	.01536
Mzuzu City	61	.0111	.00	.05	.000	.01212
Zomba Urban	34	.0105	.00	.04	.000	.01002
Total	4432	.0244	.00	.09	.001	.02253

APPENDIX U: DISTANCE TO ROADS BY DISTRICT, <10KM

Case Summaries

Kilometers to Nearest Secondary School

District	N	Mean	Minimum	Maximum	Std. Deviation	Variance
Mzimba South	219	4.02	.09	9.29	2.29612	5.272
Zomba Rural	141	3.72	.08	8.93	2.10659	4.438
Neno	41	4.54	.24	9.55	2.50143	6.257
Kasungu	269	4.66	.00	9.86	2.72194	7.409
Blantyre Rural	149	2.93	.03	8.21	1.97541	3.902
Salima	119	4.28	.11	9.67	2.23786	5.008
Lilongwe Rural West	208	4.07	.08	9.76	2.23031	4.974
Ntchisi	126	4.74	.11	8.97	2.27617	5.181
Mangochi	149	4.75	.11	9.96	2.75782	7.606
Balaka	110	4.75	.01	9.95	2.59338	6.726
Lilongwe Rural East	143	4.56	.12	9.16	2.22472	4.949
Rumphi	127	4.21	.09	9.90	2.40472	5.783
Nsanje	63	3.57	.20	8.99	2.19205	4.805
Mzimba North	198	4.02	.00	9.91	2.35124	5.528
Mzuzu City	61	1.75	.27	6.03	1.43206	2.051
Zomba Urban	34	1.21	.27	2.71	.67543	.456
Nkhotakota	132	4.03	.14	9.84	2.32656	5.413
Blantyre City	134	1.19	.01	5.76	1.24790	1.557
Mulanje	126	3.10	.05	8.90	1.90638	3.634
Chiradzulu	88	2.66	.05	6.48	1.65787	2.749
Dowa	199	3.99	.03	9.87	2.25043	5.064
Nkhata Bay	122	3.59	.15	9.76	2.35387	5.541
Ntcheu	187	4.27	.02	9.72	2.43917	5.950
Chikwawa	126	4.49	.12	9.98	2.55821	6.544
Lilongwe City	179	1.41	.02	7.89	1.33039	1.770
Phalombe	103	4.69	.14	9.70	2.20474	4.861
Dedza	169	4.43	.09	9.98	2.57779	6.645
Chitipa	147	5.15	.47	9.94	2.35585	5.550
Machinga	104	4.45	.09	9.03	2.47352	6.118
Thyolo	181	3.85	.05	9.97	2.48587	6.180
Karonga	145	4.10	.18	9.87	2.27843	5.191
Mwanza	31	4.45	.11	8.71	2.60001	6.760
Mchinji	123	5.23	.08	9.95	2.63199	6.927
Total	4453	3.93	.00	9.98	2.47974	6.149

APPENDIX V: TOTAL PASS RATE AND ZONAL CATER CLUSTERS

Total Pass Rate Cluster	School Selected (Y/N)	# of Schools
Not Significant	Not Selected	2750
	First Choice/Alternate	203
	Total	2953
High-High Cluster	Not Selected	651
	First Choice/Alternate	51
	Total	702
High-Low Cluster	Not Selected	191
	First Choice/Alternate	20
	Total	211
Low-High Cluster	Not Selected	185
	First Choice/Alternate	5
	Total	190
Low-Low Cluster	Not Selected	608
	First Choice/Alternate	18
	Total	626
Total	Not Selected	4385
	First Choice/Alternate	297
	Total	4682

Zonal Cater Cluster	School Selected (Y/N)	# of Schools
Not Significant	Not Selected	2838
	First Choice/Alternate	213
	Total	3051
High-High Cluster	Not Selected	526
	First Choice/Alternate	7
	Total	533
High-Low Cluster	Not Selected	160
	First Choice/Alternate	2
	Total	162
Low-High Cluster	Not Selected	99
	First Choice/Alternate	8
	Total	107
Low-Low Cluster	Not Selected	761
	First Choice/Alternate	67
	Total	828
Total	Not Selected	4384
	First Choice/Alternate	297
	Total	4681

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