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Agricultural Agglomeration

Infrastructure and Agricultural market integration for emergent farmers

by

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Abstract: This thesis seeks to explain constraining effects of distance to markets on agricultural smallholder's ability to commercialise, using Zambia as a case. Despite a growing consensus that inaccessible markets constrain the development of broad-based agricultural growth, creating socio-economic regional disparities, the exact nature by which distance and market access interact with agricultural producers remains under-examined. Inspired by theories of New Economic Geography, this thesis sets out to investigate one of such constraints. Agricultural inputs are regarded as paramount for production of goods. However, a combination of distance and poor physical infrastructure is suspected to increase the costs of inputs, generating either lower net incomes or making it not feasible to acquire, thus constraining smallholders' opportunity to commercialise and enforcing regional disparities. The inputs that have been identified in this thesis as relevant are education, capital assets, credit and fertiliser. By using a combination of spatial and descriptive statistics as well as mixed model regression, this study has, to some extent, found support of the negative effects of distance to markets and input use. According to the mixed model regression, fertiliser use increased with distance travelled, however, mainly for the larger farm groups. Moreover, simple scatterplots did also indicate a relationship between higher prices for fertiliser and distance. Although only explaining a small fraction of the relationship, use of credit products decreased as distance increased. Further, a combination of descriptive and spatial statistics also indicates that there is a regional disparity in the level of education and amount of capital assets. Although that the author remains cautious of concluding on these results, it is suggested that greater market access, in terms of inputs, education and knowledge sharing for smallholders would increase their chances of engaging in commercial activities.

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1 Introduction

In the past decade a much-needed shift has occurred in the focus on development aid and development projects toward greater productivity enhancement in the agricultural sector and improvements in infrastructure in both communications and in transport. Poverty alleviation through infrastructure improvements appears on the agenda of many developing nations, especially in Sub-Saharan Africa (SSA), manifested in goals for expansion and improvement of physical infrastructure (United Nations, 2013). Yet, with the increase in speculative land acquisitions in SSA by 'nonlocal' investors, the proximity of a new, significant infrastructural project could have unwanted consequences for small-scale farmers' potential for upward mobility, due to new constraints on land-access and new foreign (i.e. nonlocal) competition. 'Foreign' access to new cropland and rural local access to new markets have already proven problematic for small-scale farmers, on whom the effects of infrastructure are often overlooked. Despite an academic symposium on infrastructure, economic growth, and the importance of small-scale productivity increases, in terms of spatial economics and agricultural producers, 'winners and losers of greater integration' seems to be an overlooked subject.

Since 1994, the World Bank (WB) and the African Development Bank (ADB) have committed considerable time and sums to infrastructure projects in developing nations (Shakaratan & Briceno-Garmendia, 2011). Furthermore, following the food and commodity price crisis of 2008, private sector actors have taken advantage of this situation by positioning themselves in control of upstream value chains, creating increased demand for large tracts of farmland throughout SSA (Schoneveld, 2014). This puts even further pressure on the argument for a broad-based approach to agricultural development, as small-scale commercialisation has yet to be achieved (Collier, 2008). The improbability of small-scale commercialisation has been advocated due to lack of capital accumulation, land expansion, and increases in productivity among smallholders, significantly constraining their production and marketing abilities (Collier & Dercon, 2014).

Linking infrastructure to the growing implications of small-scale farmers' limited access to new cropland and inability to accumulate capital, most investments in land display a tendency to agglomerate around urban centres and along existing physical infrastructure (Sitko & Chamberlin, 2015). It has previously been argued that access to markets is crucial for the commercialisation of small-scale farmers as their transaction costs decrease when their market access increases (Sitko & Chamberlin, 2015). However, the debate includes contrasting views that claim loss of domestic/local markets due to increased competition and inequitable growth.

1.1 Research Problem

Determining small-scale farmers' access to markets using traditional measurements of access, often measured as distance to nearest main road, rail line, or nearest town, lacks insight (Jayne & Chapoto, 2011) by omitting the importance of private entrepreneurial ingenuity. Private assembly traders (otherwise labelled 'briefcase sellers') facilitated such access to the market for the small-scale farmers situated in inaccessible peripheral areas (Jayne & Chapoto, 2011). This calls into question the traditional constraints that limited market access imposed on the small-scale farmers' ability to commercialise. Hence, questioning small-scale farmers' ability to commercialise calls for consideration of other factors as well.

Over the last two decades, Zambia has seen an increase in funds for infrastructure (United Nations, 2013). Aside from extending the road network, this has led to a new railway project that links its existing north-to-south railway network to that of Malawi. This establishes a railway corridor to Nacala in Mozambique and, in turn, provides access by way of Malawi to its deep-water port, granting access to the Indian Ocean and the international market. Better integrating the Eastern Province could present its agricultural producers with improved market opportunities and better connection for rural dwellers to policy programmes, such as fertiliser subsidies and output marketing by the Food Reserve Agency (FRA). But, as mentioned, new initiatives might also result in more extensive foreign investments in land and increased competition. Zambia, one of the most significant destinations for farmland investments, has recently seen a total number of 40 investment projects accumulate over 1.8 million ha of land (Schoneveld, 2014). In addition, an unprecedented increase in the acquisition of medium-scale farm land has appeared in Zambia (Jayne et al., 2014). However, the recent medium-scale acquisitions are not primarily due to a rise in opportunities for small-scale farmers, but rather a result of speculative behaviour among the elite urban class (Sitko & Jayne, 2014). This raises concerns on two levels: first, the potential for agricultural productivity increases, in terms of underutilisation of cropland and potentially available cropland (PAC); and second, the restriction to new land grants for the small-scale farmers and, thus, the constraint on equitable growth and development.

Regarding the issue of market access, the lack of infrastructure has stopped rural producers at the periphery from accessing output markets. Most producers selling below 25 bags of maize per harvest have preferred to sell to a private assembly trader, more economically feasible than travelling to the nearest formal market. The distance travelled to the nearest point of sale would be zero kilometres because the majority of assembly traders would collect at each farm. Most small-scale farmers rarely produce more than 25 bags of Maize per harvest (Jayne & Chapoto, 2011). Thus, the Crop Forecast Survey from 2009 (CFS '09), as presented by Jayne and Chapoto (2011), indicated that assembly traders accounted for more than 90% of all maize trade by farmers.

Despite access to output markets facilitated by assembly traders, there is no evidence to suggest that farmers situated in the periphery are not suffering from higher transaction costs, at least in terms of inputs. Such costs hamper their potential to raise productivity, commercialising their production and engaging in upward social mobility. Such inputs can be both endogenous and exogenous to the agricultural production process.

In 2011, only 27.4 % of farmers with land holdings below 4.99 ha received subsidized fertiliser (MACO/CSO Crop Forecast Survey, 2010/11 as presented by Jayne et al., 2011, with own calculation). It seems that the reason is due to the spatial geography of most small-scale farmers leaving distance to the nearest point of distribution still too far away (Sitko & Chamberlin, 2015). Most small-scale farmers use private sellers for fertiliser (Jayne & Chapoto, 2011). However, as the Farmer Input Support Programme (FISP) increased in scale, private sales tended to diminish, and distance travelled to the nearest commercial fertiliser retailer increased (Jayne & Chapoto, 2011; Mason, 2011). Such findings could indicate that acquiring direct inputs is costly, thus not attainable for many small-scale farmers. Besides direct inputs such as fertiliser, other variables such as level of education appear to correlate with small-scale farmers' access to markets (Mukwevho & Anim, 2014). Determining whether the supply side of schooling, as well as costs, could be correlated with the centre-periphery problematic could provide further insights into the importance of infrastructure. As seen in many previous studies, the level of education is negatively related to distance (Lincove, 2015).

This suggests that one of the main constraints on small-scale farmers' ability to commercialise is high transaction costs on several direct and indirect inputs of production. In turn, the relatively high transaction costs are connected to the centre-periphery issue and lack of efficient infrastructure that many small-scale farmers face. Granting small-scale farmers better land access at the clusters and better integrating peripheral areas through improved infrastructure could enable farmers to reduce both their indirect and direct production costs, creating greater incentive to save and invest. Therefore, investigating the relationship between infrastructure and cost of inputs becomes relevant.

1.1.1 Aim & Research Questions

Through comparative analysis, this thesis aims to apply spatial observations of smallholders to traditional patterns of agricultural transformation. Therefore, this paper will explore the importance of spatial economics for emergent farmers and the prospect of achieving a broad-based commercial strategy in the presence or absence of physical infrastructure. Specifically, this paper investigates the characteristics of small- and medium-scale households in the peri-urban and the peripheral regions of Zambia. The study empirically assesses the constraints on and benefits to factors of production for the emergent agricultural household that correlate with clear distinctions among districts of Zambia. The purpose is to challenge the current focus on agricultural development, raise awareness of winners and losers of greater agricultural integration, and emphasise the importance of infrastructure to the process of broad-based agricultural transformation.

In its mission to achieve a satisfying answer, the following research question, followed by its sub-questions, guide this thesis:

- *What are the socioeconomic differences between members of agricultural households in integrated peri-urban areas and detached peripheral regions?*
    - *How is access to education characterised between peri-urban areas and detached peripheral regions?*
    - *How is the level of capital assets characterised between peri-urban areas and detached peripheral regions?*
    - *How is the access to credit products characterised between peri-urban areas and detached peripheral regions?*
    - *What effect does distance to market have on fertiliser use?*

1.2 Contribution

The thesis differentiates itself in the way that it mainly focuses on the impact of infrastructure on the small-scale farmers' ability to commercialise. As previously seen, greater integration produces higher aggregate output and enhances productivity (Pinstrup-Andersen & Shimokawa, 2006). However, there is minimal research analysing the disaggregated effects of greater integration, with a focus on equitable growth. This thesis sets out to investigate potential differences between agricultural producers in the well-integrated, peri-urban centres and those in the remote peripheral regions, in light of the establishment of new and expanded physical infrastructure. This is done partly by analysing the status of agricultural factor inputs for smallholders situated in proximity to the peri-urban regions along the existing north-south railway line, in contrast to those in the periphery, and partly by comparing and contrasting current development status of agricultural groups in the central clusters and at the periphery.

While generally distinguishing between small- and large-scale farming at the 20 ha threshold, two further distinctions are made for the purpose of this study. First, smallholders are grouped into two bodies: small-scale traditional farmers cultivating between 0.1 and 4.99 ha of land; and medium-scale emergent farmers cultivating between 5 and 20 ha of land. The small-scale farmer is traditionally characterised as a self-subsistent, undynamic, capital-poor producer, with an inept management style and educational level, thus limited in his/her opportunities for commercialisation.

In comparison, the medium-scale farmer is characterised as occupying the transitional territory between small-scale and large-scale farming, with greater access to capital, more dynamic and possessing a higher level of education and better management skills. As a result, they have greater opportunities for commercialisation (Jayne & Sitko, 2012). Yet, a large proportion of emergent farmers are not characterised by rural capital accumulation, but rather as an investment opportunity for elite urban buyers (Sitko & Jayne, 2014). Second, the location of the household determines the opportunities provided. Clusters of agricultural producers in the peri-urban centres are characterised by greater market access, hence greater opportunities, but also greater challenges to engaging in commercial activities. Peripheral producers face fewer constraints in terms of competition from market, but have fewer opportunities as well.

By conceptualising the nature of small-scale and medium-scale farmers through incorporating a clear distinction in size, in distance to infrastructure, in input costs, in level of education, in the amount produced and in net income and size of the land hold, this thesis hopes to uncover the dynamics between small-scale farming and market integration through physical infrastructure and agglomeration. Defining the overall framework and analysing historical and current data within set parameters makes it possible to study the effects of greater integration through physical infrastructure on equitable growth within the agricultural sector, and how this corresponds to the current political framework.

The overall framework is partially inspired by principles of New Economic Geography (NEG) theory which has been combined with principles of production and agricultural development. Within this framework, the research questions will attempt to be answered through a combination of descriptive statistics and econometric modelling. Controlling for nested data a mixed model is used in order to infer details of the relationship between the use of fertiliser in relation to distance to the market. It is worth pointing out that not all the variables were found to be suitable for regression analysis. This could also be due to the limits of the author.

1.3 Outline of the Thesis

This thesis is structured around the research questions, with the aim of providing fulfilling answers by guiding the argument through a historical and theoretical framework shaped and built upon the agricultural and infrastructural development in Zambia, and upon theories pertaining to agricultural transformation and spatial dynamics of the agricultural sector.

The outline of this paper is as follows. The next section briefly considers the historical events that shaped or altered the path-dependency of Zambia's agricultural economy and policy framework. It focuses on the impact of colonisation and agricultural settlers on the policy environment and mode of agricultural production, from the establishment of the Line of Rail in 1911 until the end of Zambia's one-party system in 1991.

Next, a review of previous research will add to the wider debate on agricultural transformation and its necessity for small-scale farming, infrastructure and access to markets. Subsequently, presentation of the analytical framework and model suggests a slightly modified approach to spatial economic theories, in order to better accommodate an agricultural sector in a developing country. The following sections will present the data and methods applied for the analysis. The analysis will be preceded by an account of general reginal differences pertaining to Zambia. The analysis will follow the outline of the research questions. The data for fertiliser were found to be suitable for three-level mixed model regressions, and these will proceed the descriptive analysis at its section. Finally, the conclusion will be presented giving a hint of potential for future research areas.

2 Zambia's infrastructural and agricultural development

Zambia is a landlocked country, so physical infrastructure, both within and outside its borders, is paramount for ensuring its efficient access to markets. The railway was completed in 1911 by the British South Africa Company (BSAC), originally a by-product of the mining sector but having made a historical impact on the agricultural sector as well. It was originally built for efficiency from an engineering perspective, to extract resources from Northern Rhodesia toward the South (Darby, 1931). Yet, it did have a significant impact on agricultural development. Not only did it provide access for agricultural settlers; it was also located amid some of the best soils in Zambia (Jenkin, 2018). Economically, it allowed for greater flow of capital and labour and was widely used, as Zambia had only 43 miles of all-weather roads and 1,900 miles of rail, since expanded by 1,148.5 miles in 1975, and additional projects have commitments (Dominguez & Foster, 2010; Jenkin, 2018). In short, its existence meant an agglomeration of agricultural settlers and workers around the railway.

Even today, Zambia's infrastructure plays a significant role. The African Infrastructure Country Diagnostics report of 2010 argues that if Zambia could improve its infrastructure to the level of the middle-income tier, it would mean an increase in annual growth performance by as much as 2.6% per capita (Dominguez & Foster, 2010).

Rail transport continues to be the most competitive means for large bulk commodities, such as agricultural goods and copper. Zambia has two rail operators: Railway Systems of Zambia, which serves the north-south line, and the Tanzania and Zambia Railway Authority, which serves the eastern route from the Copperbelt to Dar es Salaam (Dominguez & Foster, 2010). Currently, Zambia faces difficulties with its physical infrastructure on two accounts. First, although Zambia has a good main road network on par with middle-income countries, its rural network has long suffered neglect. While the average low-income country has around 60% of the rural network in good/fair condition, Zambia only has 21% of its rural network in similar condition. Despite 70% of Zambians depending on agriculture for their livelihood, only 17% of this population lives within a proximity of 2 km to an all-season road (Dominguez & Foster, 2010). Second, due to monopolistic powers that heavily discriminate against certain areas and commodities, the rail network is vastly underperforming. This results in low traffic densities making it difficult to retain enough earnings to even maintain the system (Dominguez & Foster, 2010). Improving the infrastructural network could mean more competitive prices and, thus, greater incentive for the agricultural producer to engage in commercial activities.

White settlers of European descent predominantly owned the agricultural settlements. In 1921, around 504 Europeans were listed as farmers, cultivating a combined sum of 29,000 acres of maize. Most of these farmers were located around the line-of-rail; however, another significant farming group was found in the East, in what is now known as Chipata.

The high-value potential of the tobacco grown here made the high transport costs due to the isolation viable nonetheless (Jenkin, 2018).

The presence of the settler agriculturalists during the colonial period was not only felt on the concentration of farms around the line of rail, where they ultimately displaced local African producers, but also on the types of crops grown and the methods employed. The traditional African agriculture was mainly divided in two: the semi-permanent hoe-cultivation and cattle-rearing in the South, and the slash and burn technique, known as Chitemene, used in the North (Baldwin, 1966). However, the colonial powers banned Chitemene, most likely for tax-collection purposes and to push labour toward the mines, despite the fact that the method generated a higher millet yield (Moore & Vaughan, 1994).

The drive to extract resources from the mines quickly meant a greater need to service the mining sector. As the African producers could not provide enough foodstuffs, a push for the extension of settlers' activities became a reality (Jenkin, 2018). First, this changed the composition of agricultural activities into cattle production and the cultivation of maize and other staples. Second, it led to the displacement of local production, which resulted in the first creation of reserves in Zambia in 1904, and the move toward new agricultural areas further into the rural areas. The effects of these changes are still seen today.

Further, the expansion of settler agriculture aroused a need for agricultural labour. Disproven today, the general conviction then stated that local producers would benefit from the trickle-down theory by utilising newly attained knowledge and capital from agricultural employment at large-scale farms (Jenkin, 2018).

Although not benefitting the smallholder directly, it was previously argued that European agricultural methods have had spillover effects that have resulted in the rise in opportunities for a new class of emergent farmers (Jenkin, 2018). Despite very few efforts, the colonial period was mainly characterised by favouritism of agricultural settlers at the expense of local producers.

After the colonisation period, during the one-party system of President Kaunda (1964–1991), Zambia saw an increase in policies on local agriculture and maize production. Foreign settlements and investments were restricted, and several local farmers seized new opportunities. New government initiatives moved several small-scale farmers out of self-subsistent production and into semi-commercial territory. However, the policies further reinforced regional disparities. As seen in Table 1.1, the central areas previously dominated by settlers and adjacent areas saw the greatest shift towards semi-commercial farming.

Table 1.1 Distribution of Farming Population, in Percentage by Farm Category and Region

	Large-Scale Commercial	Medium Scale Commercial	Small-Scale Semi-Commercial	Subsistence / Traditional	Total Population (millions)
Central, Southern, Lusaka, Eastern					
1969	3.8	9.7	34.8	51.7	1.402
1980	2.4	12.7	49.9	35.0	1.543
Copperbelt, Luapula, Northern, Western, North-western					
1969	0.0	0.3	5.2	94.5	1.563
1980	0.0	0.4	8.8	90.8	1.696

Source: Wood (1990), as seen in Jenkin (2018, p. 128)

The central areas increased by approximately 15 percent, in comparison to only 3 percent for the remaining regions. Further, the widespread implementation of agricultural policies meant a greater tendency toward corruption (Jenkin, 2018).

After 1991, new agricultural policies have been implemented, supporting both maize markets and emergent large-scale farmers. Restrictions on foreign investments have been alleviated, and an increase in agricultural investments by foreigners has been observed (Jenkin, 2018). Still, the path-dependency strengthens the regional disparities, as most investments go toward the area with the best access to markets and the most factor endowments, namely, the central region along the rail line. Based on data from the Zambian Development Agency, Jenkin (2018) calculates that 88.11 percent of all foreign investments in agriculture take place in close proximity to the North-South railway, excluding the Lusaka district. This makes up around 64 percent of the value of total agricultural investments that foreigners pledged in the period between 1992 and 2016 (Jenkin, 2018).

Agricultural, post-colonial policies were highly characterised by a strive for greater food security, which lead to a dual agricultural sector comprising of large-scale settler and indigenous farms and self-subsistent smallholders (Hillbom & Jenkin, 2018). An increasing encouragement of smallholder production during the independence era changed the production structure of farmers in Zambia, resulting in medium-scale farmers accounting for 80% of the total maize production in 1990. Despite a sharp decline in agricultural subsidies in 1991, due to a severe economic crisis, many smallholders still relied on input subsidies throughout the 1990s resulting in the establishment of the FRA in 1995.

The focus on broad based agricultural growth was given new life in the WDR'08 and ensured a return to more potent policies for market distortions and subsidies for smallholders (Hillbom & Jenkin, 2018). In a period from 2004/05 to 2010/11, maize prices were kept at 17–19% above average market price and input support programmes, named Farmers Input Support Programme (FISP) in 2009/10, dispersed annually 180,000MT to 900,000 farmers (Hillbom & Jenkin, 2018). As a result, Zambia became a maize net-exporter in 2007 and has been ever since, crops grown has seen an increase in diversity towards varieties such as cassava and more horticulture, which can generate higher yields but also at a greater risk, productivity has risen and there has been a rapid increase in medium-scale, emergent farmers.

However, as identified by Hillbom and Jenkin (2018), there seems to be several underlying problems with the recent growth pertaining to spatial path dependency. Most of the Zambian population, 54%, resides within provinces situated along the Line of Rail, mainly the Central, Copperbelt, Southern and Lusaka provinces. These four provinces account only for 31% of Zambia's total land area but produce 53.2% of all maize. Further, Sitko and Jayne (2014), warns that growth of emergent farmers seems not to emanate from successful accumulation of subsistent farmers but rather it is based on land acquisitions and commercialisation of well-off urban salary receivers.

Thus, colonial path-dependency and the presence of the rail heavily influence the agricultural process. This generates and reinforces regional disparities and omits several local producers from the opportunity to engage in commercial agriculture. Therefore, efforts toward closing such regional gaps should be made by increasing the infrastructural network, which could further mediate factors of production toward the peripheral areas.

3 Theory

The following section will discuss the previous research and generally held convictions on agricultural development. However, the thesis is limited in the sense that it mainly focuses on transportation infrastructure, in relation to its impact on small-scale farming and production capabilities. It touches upon land and rural-development policies, but for the sake of comprehension, these are not discussed or considered in depth. Further, the thesis acknowledges other constraints imposed on access to markets, which infrastructure alone cannot solve.

3.1 Previous Research

3.1.1 Why is small-scale agriculture important for SSA?

Development economists have debated the role of agriculture for decades. Early studies during the 1950s wrongly concluded that agriculture is unsuccessful in spurring economic growth, functioning only as a supplier of food, capital and labour to more productive sectors. Its role has changed significantly, the World Development Report in 2008 (hereafter WDR '08)—the first on agriculture in 25 years—underlined its importance. Many of the SSA countries have experienced one or more decades of impressive growth rates. Having benefitted from an increase in copper prices, Zambia has also experienced an increased interest from foreign investors, especially in cropland, as well as public expansion in large-scale infrastructure projects (Jenkin, 2018). Therefore, the foundation of this thesis is on the agreed-upon importance of agriculture for development and on the latest trends in economic growth.

None of the SSA countries have experienced agricultural transformation, as Timmer (2009) describes. According to Timmer, the perception of agriculture originates from the idea that no sustainable economic development or growth has ever occurred without a significant transformation of the agricultural sector. Timmer (2009) argues that cross-country evidence indicates that almost all developed countries saw a structural transformation mainly in three areas: first, a declining share in overall output and employment in the agricultural sector; second, rapid urbanisation; and third, declining mortality and birth rates. Agricultural transformation is seen, therefore, as a keystone for economic development and growth.

As mentioned, agriculture was initially perceived as a slow and unproductive sector that only existed for subsistence purposes, upon which the more productive sectors could draw labour and other resources. This possibly could have been based on misinterpreted ideas, first proposed by Lewis (1954). Consequently, the agricultural sector was subjected to over-taxation and pro-urban development planning. Auspiciously, the 1960s and 1970s saw a change in attitude toward the sector. Contributions made by Johnston and Mellor (1961) and Schultz (1964) advocated agriculture as the leading sector in the early stages of development.

Further, a study by Christiaensen, Demery, and Kuhl (2011) indicates that agricultural development is the most effective tool for lifting income among the most deprived rural dwellers, The below-one-dollar-a-day income segment, characteristic of most of SSA, including Zambia.

Accordingly, the WDR '08 establishes agriculture as a vital tool for achieving the millennium development goals (MDG), poverty reduction being a top priority. By 2007, three-quarters of the population in developing countries lived in rural areas and depended, either directly or in close indirect links, on agriculture (World Bank, 2007). Hence, a proclivity toward greater agricultural development by productivity increases has been suggested ever since. For SSA, a plethora of academic research predicts that agricultural productivity increases for smallholders and support of self-subsistent farmers will spur overall growth, alleviate absolute poverty and enhance food security. The allure of such an inclination is that almost all SSA economies are largely agriculturally based.

Therefore, agriculture and its associated industries are key to growth, securing food and efficiently combatting poverty, as it is a source of income for most of the rural population (Christiaensen et al., 2011). According to the WDR '08, inconsistent domestic production reduced foodstuffs' potential as a tradable commodity, and small foreign-exchange reserves have led to the recurring food crisis.

With the latest projected human population, a critical situation arises, which by itself seems threatening enough: ‘How do we feed the world’s current and projected population?’ The answer seems easy enough. There is plenty of agricultural potential hidden in the African continent. For example, only 12 percent of potential agricultural land in Mozambique, Tanzania and Zambia is cultivated (Laishley, 2014). Unlocking Africa's agricultural potential would not only sustain its projected population—soon the fastest growing in the world—but also a sizable proportion of the world's population. Hence, the critical situation is the progenitor of why agriculture is the overarching theme when discussing economic development in a country such as Zambia. The theme of agriculture could also extend to the entire continent of Africa. Its heterogeneity is habitually neglected, and therefore a complete analysis often seems unmanageable and futile. Globally, agriculture provides a livelihood for around 86 percent of the rural population, with a drop from 28 to 22 percent in the $1-a-day segment in the period 1993 to 2002 (World Bank, 2007). Better conditions for the rural population are attributed to better rural development, as opposed to out-migration of the poorest to urban areas. However, for the SSA countries, the actual proportion of rural-poor has increased (World Bank, 2007). For East Africa, rapid growth rates of over seven percent have been experienced over the past 10 to 20 years (McMillan & Harttgen, 2014). Even more significant is the nature of the recent growth.

Despite not having undergone a structural transformation, agriculture's share of GDP for Zambia, as well as for many other countries within the SSA region, has dropped. McMillan and Harttgen (2014) contend that much of the growth can be attributed to a diversified product range and agricultural investments in cash-crops and horticulture. Yet, it is still the general belief that structural transformation, which frames much of the universal, academic research today, is yet to happen (Collier & Dercon, 2014).

The literature on agricultural transformation for Africa is often generalised for the entire continent or does not specify the exact means and consequences by which higher productivity for the agricultural sector must happen. Propagating the necessity for higher agricultural productivity among small-hold farmers, while foreign large-scale farmers establish themselves in SSA to a greater extent than ever before, is a quagmire. Although not widespread, there has been an increased focus on the effects that large-scale farming, including foreign investments in agriculture, has on the small-scale farmer. In spite of a potential increase in production, the presence of foreign investments in the agricultural sector can still have distortionary effects, as they threaten to outcompete local producers (Jenkin, 2018).

Further, Jenkin (2018) also found a clear relation between foreign investments, both currently and historically, and infrastructure, especially in the form of railways. Therefore, the newly commissioned railway link through the Nacala corridor could present new marketing opportunities, as well as greater incentive for increased foreign interests (African Development Bank, 2009). Nonetheless, as previously mentioned, such new possibilities open up the potential for market displacement through greater standardisation and competition. Little research has been done in terms of consequences this might have on the livelihood on small-scale farmers.

3.1.2 Land policies and smallholders' access to markets

As stated above, the World Bank (2007) propagates agriculture as the tool for alleviating poverty, pinning its argument on the over 75 percent of the world's poor residing in rural areas and engaging in the agricultural sector, directly or indirectly. The necessity for agricultural development, especially in the SSA, is founded on the need not only for poverty alleviation but also for greater food stability and sustainability. The urgency of need for more significant and more effective investments in agricultural technology and infrastructure is, therefore, paramount for the productivity of smallholders. Case studies of outgrower programmes have constituted a response to the fear of increased competition, indicating that a possible increase in large-scale farms could benefit productivity of the small-scale farmer by organising and linking them to domestic and international buyers (Deininger & Byerlee, 2011). But, the potential of a new food crisis combined with new committed funds for infrastructural projects have given rise to an increase in investments by large-scale foreign investors and local urban medium-scale investors (Jayne et al., 2014).

Next, the sources used in this research and then the methodology are presented. The analysis will be presented and discussed. The analysis is bimodal, first presenting and discussing quantitative results relating socioeconomic differences between the rural periphery and the peri-urban centres and, second, briefly discussing current development plans and initiatives in relation to quantitative findings and theory, and whether these include new growth opportunities for the small-scale farmer. The final section will lead to the conclusion of the research and a suggestion for more in-depth potential research.

Recent acquisitions of large-scale farms by foreign investors have raised concerns with regard to the policy framework of land rights, land governance and the crowding-out of local farmers by both large-scale investors and the emergence of medium-scale urban investors (Deininger & Byerlee, 2011). However, the response of a limited number of case studies suggests that these accusations have little evidential background (Lay, Nolte, & Sipangule, 2018). Evidence does suggest a correlation between increase in maize yields for smallholders and proximity to large-scale farmers (Lay et al., 2018). Besides benefits from an increase in productivity, the emergence of larger farms brings about the possibility of labour wages for the smallholders, thus securing a steady income base and foodstuffs (Neven, Odera, Reardon, & Wang, 2009). Such purely speculative new employment opportunities resulting in higher income security could mean more significant investments in human capital and higher consumption, provided that local employment policies can secure and uphold reasonable rights for the employee. However, the larger farm size could also result in reliance on capital over labour. Such a case pushes the small-holder entirely out of both regular employment and self-employment, as no current industry development could pick up the slack of excess labour.

3.1.3 Agricultural agglomeration and new economic geography

Inspired by the theoretical framework of Hillbom and Jenkin (2018), this thesis relies on similar dynamics of NEG, first articulated by Krugman (1991). Transport costs are found to be high for a landlocked country such as Zambia and therefore a significant disadvantage with regards to international trade. Following similar logic, this also applies to agricultural producers. Remoteness, in this case, would work as a constraint on the producers' access to domestic as well as international markets. Equivalently such a constraint could also function as a barrier to foreign competition, thus protecting local producers (Hillbom & Jenkin, 2018).

The forces of agglomeration, as described by Krugman (1991), illustrates increasing returns to scale for manufactures. The increase in returns to scale can be attributed to greater access to underlying factors of production and lower transport costs. Krugman's theory seems at first to have very limited convertibility to agricultural development, but as emphasised by Hillbom and Jenkin (2018) the mobility of factors of production, with the exception of land, and the reduction of transport costs can be adjusted to a theory on agricultural agglomeration. Likewise to manufacturers, agricultural producers will seek out areas in close proximity to markets, where transaction costs, especially transport costs, are low, population clusters are closer and access to inputs and information is greater (Hillbom and Jenkin, 2018).

3.1.4 Infrastructure

Infrastructure is perhaps one of the most important factors in terms of providing access to input and output markets and reducing transaction costs. In fact, a growing body of literature highlights the positive impact of transport or hard infrastructure on economic growth and development.

Looking at previous cases from China, it becomes clear that successful investments in physical infrastructure have a positive impact on the reduction of rural poverty. A cross-country study from inland China found that areas that invested less in transport infrastructure became more isolated and had lower incomes, lower consumption levels and lower production output than those who invested more heavily in transport infrastructure (Man, 1998). In support of this study, Démurger (2001), finds that openness to trade, policy reforms, location and infrastructure are major contributors to growth and development. He further emphasises that successful infrastructural endowments have an agglomerating effect on the population density.

In Africa, small-scale farmers are often spread out over a larger and more remote area with poor infrastructure. This restricts their access to lucrative markets and, therefore, also their potential to commercialise. Distance to market, which could be improved through infrastructure, equals higher transport costs, hence, higher transaction costs, and therefore a greater hindrance to commercialising (Kirsten, Perret, de Lange, & D'Haese, 2006). Poor infrastructure equals poor access to inputs and information, resulting in high operational costs. Due to the lack of capital, generally characterised by smallholders, higher costs mean even more difficulty competing in a larger market (Kherallah & Kirsten, 2002).

As seen elsewhere, lack of infrastructure in Zambia also affects access to information. Conservation Farming (CF) practices have seen almost unparalleled results in terms of yields. Yet, they have only been successfully implemented in areas with short distances to roads and other major transportation infrastructures. The distance to markets has been found to be negatively associated with the use of CF practices (Ng'ombe, Kalinda, Tembo, & Kuntashula, 2014). The need for better infrastructure—in some cases, roads—is generally agreed upon. Insufficient infrastructural network has been identified as negatively affecting agricultural productivity, leading to unreliable and expensive availability of inputs such as fertiliser, lack of education and moribund markets (Jorgensen & Loudjeva, 2005). As identified by the World Bank's Poverty and Social Impact Analysis (PSIA), the Road Sector Investment Programme (ROADSIP) is currently aware of this, and several projects are underway to improve the road network. However, with the involvement of several NGOs, it can be potentially difficult for the government to maintain and run the road network afterwards. Further, the PSIA and other development organisations have little focus on the impact of rail improvements on small-scale productivity (Jorgensen & Loudjeva, 2005).

In summary, better infrastructure equals greater integration and better access to input and output markets. Increased access typically results in a more formal market nature and higher competition, but also greater possibility, as well as greater push for commercialisation. Formal markets have higher requirements in terms of standardisation of products, a requirement to which many large-scale farmers can adhere because of sheer economies of scale. The differences in products occur between smallholders, due to lack of capital affecting volume and productivity (Neven et al., 2009). Commercialising small-scale agriculture may not only mean equitable growth and food security, but also growth in general.

However, many small-scale farmers situated in peripheral areas do not enjoy benefits from agricultural programmes, such as FISP. Further, the generally high transaction costs associated with living in rural areas impede small-scale farmers' chances of gaining greater agricultural productivity.

Additionally, an increase in competition could completely wipe out the smallholder's own domestic market, as cheaper and better alternatives will be readily available. In finding the best pathway for potential commercialisation of smallholders, which can ensure equitable growth across Zambia, considering several factors of production and how they interact is important.

3.2 Analytical Framework

The theoretical framework is narrowly constructed around segments of spatial economics, agricultural transformation and policy institutions, in order to better convey clarity and keep the scope of this thesis on point. The section presents possible benefits or challenges in relation to the presence of infrastructure, based on research on developed nations. It attempts to merge this with the context of potentially poor institutions, land access, the need for broadly based agricultural growth and other deficiencies with which a developing country might be faced. Controlling much of the debate on centre-periphery dynamics, this thesis draws inspiration from Krugman's (1991) theory of NEG as presented by Hillbom and Jenkin (2018).

3.2.1 Infrastructure, input markets and clusters

As discussed above, the access to output markets is not the only criteria for success among smallholders. Access to several input markets has been found to have a significant impact on the success rate of small-scale farmers. However, inputs such as capital, education, fertiliser and infrastructure are not independent variables, but often correlate with each other, relationships often overlooked.

For instance, evidence shows that greater physical infrastructure is negatively associated with input costs, and that a reduction of input costs has been found to have a positive impact on small-scale farmers' ability to commercialise (Mellor, 2014). As demonstrated by Sitko and Chamberlin (2015), most medium-scale farmers, as well as large-scale farms, tend to cluster around the major infrastructure routes, particularly the rail line. Although there might be some positive effects of close proximity to large-scale farmers, for the small-holder, it is difficult to segregate the differences in effects of infrastructure, technology, and education from the positive or negative effects of proximity to large-scale farmers and the emergent farmers (Lay et al., 2018).
Pointing to a lack of longitudinal data on small and medium agricultural groups as the reason they have been unable to take their analysis further, Lay et al. (2018) do fail to account for the evidence provided by the symposium of data from the Crop Forecast Surveys (CFS) and the Rural Agricultural Livelihood Survey (RALS), as well as that provided by Sitko and Jayne (2014) and presented in several reports of their research (Jayne & Chapoto, 2011; Jayne et al., 2014; Jayne et al., 2011; Sitko & Chamberlin, 2015; Sitko & Jayne, 2014).

Neither did Lay et al. (2018) account for the benefits of being situated in, within or near clusters as proposed by proponents of NEG (see Hassink & Gong 2019, for a review of NEG). The model explains regional economic disparities on the basis of agglomeration effects by assuming increasing returns to scale, mobility of factor of productions and transport costs being integrated in the model (Hassink & Gong, 2019). Due to greater access and low transport costs, firms will have lower costs if situated within the core region. Lower costs result in greater influx of firms further enhancing the gravity of the core region. Agglomeration can also happen based on specialisation of industries. Factors driving this trend are due to the benefits of specialised agglomeration which include specialisation of labour, agglomeration of specialised suppliers and technological spillover effects (Hassaink & Gong, 2019). As mentioned, these agglomerating effects can, to some extent, be translated over to the agricultural sector as seen in Hillbom and Jenkin (2018). Here the main benefits are the close proximity to markets which provide lower input costs, greater access to specialised services, such as veterinaries and commercial millers, and greater technological spillover effects.

With the agricultural clusters situated around large infrastructure sites, the basic understanding of the centre-periphery models apply to the agricultural sector as well as it does to manufacturing in the framework of Krugman (1991). With transaction and input costs for agriculture suspected to be higher in the peripheral areas, the benefits of being situated within the cluster should be clear. However, when the centrifugal force of land scarcity is further propelled by the increasing interest from emerging farmers and foreign investors, the small-holder is pushed farther toward the periphery.
Large investments in transport infrastructure, probably a combination of rail and road, can have a centripetal effect on the centre-periphery dynamic and give small-scale farmers in the periphery a competitive advantage, helping to generate new and more spread-out clusters (Shefer & Frenkel, 2011). New centre-periphery dynamics would therefore arise, and the chance for the small-scale farmer to commercialise would increase, probably in a combination with private entrepreneurs' assembling produce on the outskirts, but at a lower cost (Jayne & Chapoto, 2011).

3.2.2 Spatial relationship between agricultural centres and peripheries

Traditional development models usually focus on the sectoral development, more or less neglecting the spatial patterns and location of said development process. The existence of infrastructure has historically provided producers with lower transaction costs and greater access to markets, both for the industrial and the agricultural sectors. However, it has also generated discrepancies between areas, in terms of opportunities. Opening up the peripheral areas through greater infrastructure can benefit local producers and provide them with access to not only output markets, but more importantly to input markets as well, which can enhance their potential for commercialisation, thus promoting regional equity, generating welfare and reducing poverty. Traditional theories within the framework of NEG do not account for the economic potential for agricultural commercialisation, but rather choose mainly to delve into the core-periphery dynamics in intraregional industrial development (Gruber & Soci, 2010). However, applying the traditional framework to regional differences in agricultural development would require a slightly different outlook. Thus, a configuration of the traditional NEG framework is attempted here.

Traditional NEG models portray the benefits of agglomerations as mostly being mobile factors that often include spillover effects, including sharing of technology, knowledge and low transport costs. These often result in greater economies of scale and higher total factor productivity (TFP). The major constraints of the central areas are portrayed as immobile factors —in particular, land. As the centripetal effect of the agglomeration process increases in strength, land prices will increase in the area. The effects of a sharp incline in land prices means a greater spread of labour, followed by other factors such as services and industries. This shift toward a more centrifugal force spreading out input factors and industries will require greater reliance on infrastructure, in order to keep transport costs low, thus making the commute to the core feasible (Gruber & Soci, 2010). Similar effects in agriculture might also be found.

As previously mentioned, the appearance of agricultural agglomerations affects the nature of agricultural production, comparative amount produced, and land availability (Sitko & Chamberlin, 2016). For the small-scale, capital-poor producer, the centre-periphery dynamics could have significant consequences for socioeconomic status and ability to engage in commercial activities. Following simple logic of demand and supply, it is believed that greater scarcity can be used as a proxy for greater demand. As land is a scarce, immobile resource, greater scarcity means not only a rise in price, but also a push for less resourceful producers (in this case, farmers) toward the periphery, away from major roads and the line of rail. This means a significant increase in transport costs for inputs and outputs, which can prove cumbersome for the ability of small-scale farmers to commercialise.

Opening up current and new peripheral areas with physical infrastructure would have a double effect. First, it reduces prices for imported and exported goods to the region. Second, this creates incentives for private investors to locate to the area in pursuit of lower wages, generating better opportunities for local farmers to have a secondary income (Gruber & Soci, 2010). Yet, the opening of peripheral regions through infrastructure also comes at a cost. In developed countries, an opening could mean greater risk of losing the labour force or employment (Vickerman, Spiekermann, & Wegener, 1999). A similar threat might not be as apparent in a developing economy, as the relative cost of commuting in relation to the average salary might be one factor deterring a rural resident from gaining employment elsewhere outside of his/her local region, whilst still living there. Rather, due to lack of opportunities, rural dwellers would relocate to an urban area altogether.

Greater access to the core also means greater access to the periphery. Lower transport costs might therefore not only benefit the periphery, but also the core. Consequently, the peripheral areas could lose their own domestic markets to ‘foreign’ producers from the central regions. Moreover, an increase in investments from the private sector could lead to another phase of land scarcity and push the rural household farmer out toward the periphery again. As such, development of the regional infrastructure alone cannot improve the periphery.
In the case of Europe, expanding physical infrastructure in the peripheral area is not feasible if the region is not supported in enforcing its own comparative advantage (Vickerman et al., 1999). Further, as previously pointed out, one of the issues with the land scarcity in SSA is the increase in speculative investments from foreigners and the urban elite, leading to reports of the displacement of smallholders (Sitko & Chamberlin, 2016; Sitko & Jayne, 2014).

Therefore, this thesis operates under the assumption that in order for infrastructure to have a positive impact on peripheral regions, it must be coupled with correct institutional policies and support programmes that can enhance the peripheral's comparative advantage, prevent elite land-grabbing and set up favourable conditions for an urban domestic market as the main off-takers of produce. Conversely, these actions also have a very narrow effect without considerable public investment in physical infrastructure.

3.2.3 The model

Mukwevho and Anim (2014) argue that lack of infrastructure is one part of the many factors that constrain smallholders' access to the market, regardless of the effects of greater integration with large-scale farmers on the income base of the small-holder. In proving this so, they find that factors such as value of equipment and educational level largely correlate with better market access. Nevertheless, they fail to account for the correlation between infrastructure and access to education and other direct or indirect inputs of production.

Further evidence points toward a connection between productivity and market access for smallholders. Nevertheless, for small-scale farmers, constrained choices in a risky environment weaken such market access (Mukwevho & Anim, 2014), creating the need to grant smallholders better access to agricultural inputs in order to eliminate such risks. Such inputs are capital (e.g. technology, fertiliser, credit and productive assets), education, labour and infrastructure. Such access determines regional socio-economic disparities and therefore smallholders' chances of commercialising. The following paragraphs will therefore give an account of critical inputs of production in relation to the research questions of this thesis.

Access to capital: It is generally agreed that an unequal distribution of wealth, among other factor endowments, has opposed the opportunities for growth and development for many developing countries (Engerman & Sokoloff, 2002). Equal distribution of capital would provide a chance for upward social mobility, through such improvements as fairer land rights, access to water and public infrastructure. Shepherd (2007), argues that greater access to production resources equals greater potential for commercialisation. As with a classical production function, capital is one of the key elements of input. Access to capital allows for greater diversity in production methods as well as quality of products, in turn spreading the risk of price volatility and other factors that could affect the harvest. Capital gives way to the acquisition of new land and new technologies that can result in greater incomes. Further, it can strengthen the potential for education of one or several members within the household, leading to better management practices. It can also give way for better off-farm incomes that can be transferred back to the household and used to invest in new input methods, to cushion down-turns or to acquire more land (World Bank, 2007). Finally, a correlation between unequal access to capital and unequal land distribution has previously been identified (World Bank, 2007).

Access to fertiliser: Exploring the classical production function, we find that growth is not only attributed to Capital and Labour, but also to technological change, which can multiply the effects of the more 'classical' inputs several times over. Based on the previous attempts to identify causes for the Green Revolution, the keystone of the agricultural input of production has been identified as chemical fertiliser (Fan, 1991). Low fertiliser use has been found to correlate with a lower yield in both developing and developed countries. Correspondingly, SSA has a significantly low use of fertiliser, the result of market failures such as high transaction costs, resulting in fertiliser being twice as expensive in SAA as in Asia. Without the use of chemical fertilisers, there is an exposed risk to degrading the soil and significantly lowering productivity (World Bank, 2007).

In relation to the findings of the WDR '08, several fertiliser subsidy programmes have been enabled. This includes in Zambia; however, as previously mentioned, they do not reach small-scale producers in peripheral areas (Jayne & Chapoto, 2011).

Access to Education: Also hereunder, scarce agricultural extension education has been identified as a barrier to market integration. A lack of education has previously been found to correlate with a lack of market access (Mukwevho & Anim, 2014).

Smallholders are commonly illiterate, known to lack technological skills and knowledge, which can encumber their access to otherwise valuable institutions (World Bank, 2007). In combination with education is also a need for greater information. Information can be provided through nonphysical services such as text messages, interactive voice-response services and Internet database systems. But it can also be provided through rural-based information and education centres. Adaptation of new technologies has also been found to have a significant impact on smallholders' ability to commercialise and reach new markets (Doss, 2006). Small-scale farmers' ability to adopt and implement new strategies is dependent to some extent upon the level of education.

In Ethiopia, Weir and Knight (2000) find that households with one or more members with several years of schooling or access to 'site-level' education have greatly increased chances of the household's ability to adopt and diffuse a new technology. They conclude that education affects the timing and innovations of small-scale farmers by allowing them to easily adopt or innovate techniques or technologies that less educated households can copy (Weir & Knight, 2000). Therefore, education is one of the key areas that policies need to focus on improving. Supporting this argument, it was found that in the rural areas of Zambia, the consistently poor had higher proportions of households with no education—21%, as opposed to only 0.8 % for the non-poor (Chapoto, Banda, Haggblade, & Hamukwala, 2011).

Market constraints: Imposed by the forces of the formal markets, in previous cases, market constraints have led to the emergence of medium-sized farms and fast-growing commercial farms in Kenya. These farms supply directly to the formal markets in the shape of supermarkets (Neven et al., 2009). Studies have previously pointed toward the decline of sourcing agricultural produce from small-scale farmers. In the case of horticulture, Dolan and Humphrey (2000) warned how the small-scale farmer in Kenya risked being excluded from the modern market, as foreign supermarkets would gain greater domestic-market access. Their concern relates to the evidential decline of fresh fruit and vegetables sourced from small-scale farmers in the 1990s. By the late 1990s, only 18% of fresh fruit and vegetables were sourced from small-scale farmers, while the remainder of 82% came from the exporters' farms and other large commercial farms (Dolan & Humphrey, 2000). The case of better market access and the effects on small-scale farmers in Zambia is relevant, as the new and soon-to-come infrastructural projects present both opportunities and challenges for the residents in the rural areas—in particular, the small-scale, self-subsistent farmer.

For the past decade, productivity enhancements and better market integration among small-scale farmers have been the hype of development economists, as they can ensure both greater food security and equitable growth. However, with the current land policies, small-scale farmers are pressured by both domestic urban elites and foreign large-scale investors.

Figure 2.1 attempts to clarify opportunities and challenges for small-scale farmers engaging in commercial activities provided through infrastructure. At the first stage, going from left to right, the input costs for peripheral dwellers are either not very accessible, or very expensive to purchase. Rural development programmes do not reach far out beyond the agricultural hubs, situated in proximity to main infrastructural lines.

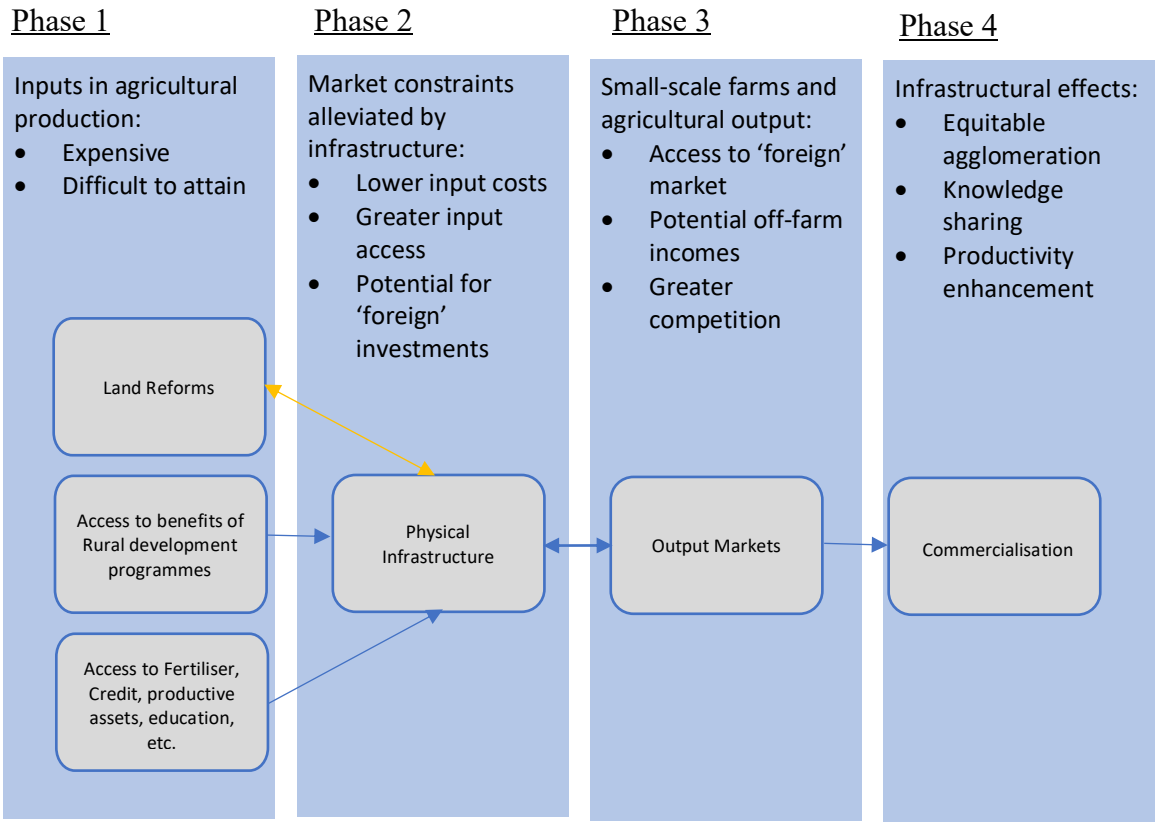


Figure 2. 1. Physical infrastructure's relationship with input & output markets for small-scale agriculture. Own Contribution

The private sector provides more conventional inputs for production, with the exception of education, and due to high transport costs, are expensive and not accessible to local producers. Lack of infrastructure ensures that the inputs do not have a very significant effect on productivity enhancements, and therefore, the small-scale farmer is trapped without the means to advance and commercialise production.

Local government policies, such as land reforms, can secure small-scale producers' ability to expand and engage further in commercial activities whilst restricting land-grabbing by nonlocal investors. Although difficult to enforce in very rural areas, it is in fact the only thing not restrained by lack of infrastructure, per se. However, without physical infrastructure, it is unlikely that local producers will be crowded out by urban elite or foreign investors in the near future, as the land in closer proximity to the core regions has greater appeal as investment opportunities. Yet, in the absence of equitable, noncorrupt government policies, and in the presence of physical infrastructure, land prices presumably will increase as investors will start to buy, thus crowding out local producers and restricting their opportunities; hence, the dual relationship as Figure 2.1 shows.

In the second phase, infrastructure has generated greater access to inputs of production, mostly by lowering the transportation costs. Many of the benefits of the core areas have moved closer to the periphery, however, so has the possibility of 'foreign' investments in land, if not managed correctly.

In the third phase, rural households have benefitted from greater market access, and agricultural productivity has risen. If pushed forward by policy makers, education and strengthening of knowledge sharing can increase as well. Therefore, output markets may not only receive agricultural produce, but one or several members of the household might have the ability to sell non-agricultural products, labour hours, or services that can generate an off-farm income. It is of importance to refer back to the aforementioned studies of the correlation between education and agricultural productivity, as to underscore the importance of education for equitable growth possibilities.

As well as infrastructure has brought markets closer to the peripheral areas, it has also brought the competition of the markets with it. Increased competition could have negative effects on the peripheral areas, draining capital and other resources away from them and towards the centres. It is therefore crucial to have policies and strategies in place that can focus on enhancing the comparative advantages and easily adapt to sudden changes.

In the final phase, higher incomes from enhanced productivity start turning into savings, which further will generate productivity-enhancing investments. Agro-industry linkages could appear, generating agglomerating effects, and the agricultural production methods will begin to appear increasingly more commercialised.

4 Data

The empirics used in this thesis outline the basis for the analytical approach, by which our field and research questions have been formulated and by which the subject is investigated, the results analysed, and the research questions answered. This is not to say that findings not corresponding to our theoretical framework will forcibly be altered or analysed with bias and explained so that it does. Rather, they will be used as steppingstones to gain higher understanding of the agricultural growth process in correlation to infrastructure improvements, which can offer insight for further investigation and elevate policy discussions.

4.1 Source Material

This study relies on survey data on small-holder agriculture collected by the Central Statistics Office, in collaboration with the Ministry of Agriculture and Livestock and the Indaba Agricultural Policy Research Institute. The surveys are the third part of the Zambia Food Security Research Project (FSRP-III) and consist of the Supplementary Surveys (SS) to the Crop Forecasting surveys, collected in 2001, 2004 and 2008, and the Rural Agricultural Livelihood Survey (RALS) from 2012.[1]The SS and the RALS surveys are very similar in type; however, the RALS-survey relies on an altered framework, based on a national census from 2010 (Sitko & Jayne, 2014). The surveys are directed at households cultivating between 0.1 and 20 ha, and thus, farmers categorised as large scale are excluded from the survey.

More than 14,000 small- and medium-scale farmers were surveyed each year. These surveys were conducted with the intention of gathering information on the area, yield and production for nine different crops. Going forward, the RALS survey also includes data on the distance travelled to the nearest point of sale for crops, as well as distance to the nearest point of purchase for fertiliser. Data on distance travelled for the remaining surveys were only collected for households selling to the FRA in 2004 and 2008. Regardless, the nature of the SS panel dataset makes it possible to track changes in market access conditions for around 4,300 smallholders. The SS surveys cover 407 Standard Enumeration Areas (SEA) in Zambia's nine provinces. Due to the intentional more regional control, in 2011, the Ikelenge and the Isoka districts were further divided into the two new Mwinilunga and Mafinga districts, meaning that the RALS survey was, conducted with 74 districts rather than 72 (Commonwealth Network, 2019).

[1] The datasets were provided by T. S. Jayne and Margaret Beaver, MSU.

By 2018, the subdivision of districts had accumulated to a total of 117, although this thesis will only focus on the 74 observed in the RALS 2012 survey and the 72 districts of the remaining pre-2011surveys.

In the 2004 and 2008 SS surveys, the household disclosed information on market access in terms of both outputs and inputs. The indicators were: kilometres distance to the nearest district town; the nearest wholesale maize market; the point of sale for the largest maize sales transaction; the nearest private fertiliser retailer; the nearest buying point of the Food Reserve Agency; and distance travelled to nearest FISP subsidised fertiliser collection point (Jayne & Chapoto, 2011).

The RALS survey is a reconfigured version of the previous CFS on the basis of the 2010 population census, from which the population density also has been drawn. The purpose of the RALS12 survey is to obtain information that is not normally obtained from the government agricultural surveys. The survey covers both urban and rural areas and provides district representation of the Eastern Province and provincial representation of the remaining nine provinces. The sampling frame has been dictated by the 2010 Census of Population and by utilising probability proportional to size; the survey consists of 442 SEAs.

Data on large-scale farming acquisitions in SSA are difficult to obtain as the disaggregated data is rarely publicly available. Although politically sensitive in nature and therefore limited with respect to public access by most governments, the data is in most cases not centrally administered and often through noncomputerised systems (Schoneveld, 2014). This indicates that the vast majority of governments themselves are not fully aware of the scope and scale of large-scale land acquisitions. As a result of poor intragovernmental coordination and limited information provided by investors, even fundamental investment details have been found lacking (Schoneveld, 2014). The Land Matrix,[2] an independent initiative for monitoring investments in land, usually draws its data from research reports and other reliable sources and has been cited in research by Anseeuw et al. (2013) and Kugelman (2012).

However, the initial version of the Land Matrix initiative has been criticised for reliance on media reports and including both verified as well as unverified deals, without creating any distinction between the two (Schoneveld, 2014). The Land Matrix has since then improved the quality of its data. The version of the dataset employed for this analysis distinguishes between status of investments, types of sources, location and verification. For this thesis, the data for Zambia has been drawn out and cleaned. All observations reported by media have been omitted, together with projects no longer in operation or abandoned. It is acknowledged that the validity of this data is still not perfect, which is why the data will mainly serve as an indicator of the spatial location of large-scale farms in Zambia.

[2] The Land Matrix initiative provides details on foreign investments for developing regions. It relies on crowd-sourcing and is led by the International Land Coalition (ILC). It includes projects established after January 1, 2000, exceeding 200 ha in size.

Further, the analysis has employed several map files and polygons pertaining to the Zambian road network. The map files were obtained as Stata usable shapefiles from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). The OCHA updates its files once a year; however, the polygons pertaining to the different districts are from 2012. As Zambia is undergoing rapid centralisation, the total number of districts in the shape file differs from the actual current number. The 2012 districts comprise of a total of 72 districts. The actual current number of districts is117.

5 Methods

The general purpose of this study is to analyse and observe socioeconomic differences between and new opportunities for market participation and commercialisation of smallholders in relation to the infrastructural network and clusters. It is suspected that the diversity of Zambia's agricultural sector and its members has been shaped by historical trajectories that, therefore, are very high. Thus, it is necessary to identify and analyse them across several common parameters. Further, in order to identify new opportunities for smallholders in relation to development plans, a brief review of the desired development plans has been carried out in relation to the findings of socioeconomic status and the effect that infrastructure might have on them, respectively.

The household survey data was recorded in 2001, 2004, 2008 and 2012. The format of these surveys has changed slightly throughout the year; however, much of the same information is still retained within each survey. When possible, longitudinal data gives a better understanding of the development of the effects of agricultural support programmes for smallholders. Problems does however arise as not all interviewed household reappear throughout all years and controlling for this has proven difficult. Therefore, the data here will be treated as a repeated cross-sectional study. The necessary data has been identified for each survey and reorganised for comparisons to be made where they were found to be relevant. The general analysis is based on comparing and contrasting descriptive statistics for the appropriate observations. Such observations are guided by the research questions and the analytical framework and include reported distance to markets, size of cultivated land, educational level, price for and use of fertiliser, use of credit and value of productive assets. Further, for the sake of greater contrast, it was decided to subdivide the current groups of small- and medium-scale producers by two for some of the analysis. Much of the analysis is compared and contrasted to similar or other relevant findings by other researches. This is done to control the validity of the findings and to discuss their relevance. Most of these variables are observed and explained using descriptive statistics in a combination with spatial data on Zambia.

In particular, this study utilises spatial polygon data that provides a visual representation of Zambia, its districts and its main road systems, in this case, Trunk roads stretching from south to north and from the centre to the east. This data is merged with findings and observation from the CSO and the household observation, to yield a greater understanding of the historical trajectories imposed by the Line of Rail. In addition to the geographically observed road network, observations for the minimum type of infrastructure per district has been manually reported for all of Zambia's 72 districts (see appendix A for overview). This was done by comparing and contrasting road networks from the online map tool on the OCHA's website, as it was generally more fluent to use than the STATA 13 interface.

Although the nature of the data makes it, in some cases, difficult to use for regression analysis, it is here argued that while simple OLS regressions might not be adequate in order to analyse a significant relationship between distance and factors of production as this does not account for

nested design of the data, using a mixed method model will. Using the mixed model approach, we manage to violate the assumption of independence, which would lead to type 1 error rates.

Due to the vast complexity and nature of the datasets used, in combination with the limited experience of the author in working with such datasets in STATA, there has been several limits to what variables where suitable for regression analysis and how.

The main variable where successful regression analysis was constructed fertiliser. Using a general to narrow approach starting with simple regressions and testing for relevance we ended with the following to hierarchical linear models for the analysis:

$$Distance_{ijk}=(\gamma 00+u0k)+\gamma year_{ijk}+\gamma fertq_{ijk}+\gamma fert\_source_{ijk}+ \gamma fert\_source_{ijk}* \gamma fertq_{ijk}+\gamma+e_{ijk}$$

And

$$Distance_{ijk}=(\gamma 00+u0k)+education_{ijk}+land\_size_{ijk}+\gamma fertq_{ijk}+\gamma fert\_source_{ijk}+\gamma fert\_a_{ijk}+\gamma fert\_source_{ijk}*land\_size_{ijk}+\gamma fert\_source_{ijk}*education_{ijk} +education_{ijk}*land\_size_{ijk}+\gamma+e_{ijk}$$

The three-level Hierarchical model, or mixed model, is applied in this thesis in order to account for nested data structures. Based on a broad-to-narrow approach, where testing for significance, and the Akaike and Bayesian information criterion the models are determined. The models are constructed on the household as level one, the ward within the district as level two and finally the province as level three. The three-level model is deemed appropriate, as it seeks to explain how outcomes are forecasted by not only level-1 and level-2 predictors, but by level-3 predictors too. The three-level HLM is therefore significant for the analysis as it computes cross-level interactions of predictors in for the relationship between distance and fertiliser use, regardless of the complexity of interpreting such interaction effects.

The models given above are simple representations of the three-level model. In the first model, the relationship between distance, fertiliser use, and source of fertiliser are investigated over the observed years, 2001, 2003, 2004, 2007, 2008 and 2012. $Distance_{ijk}$, is the reported distance travelled in kilometres to the fertiliser pick up point by household *i*, associated by ward *j* in province *k.* The predictors are year, fertq, which is the quantity of fertiliser in kilograms and fert_source, denoting the source from which the fertiliser was acquired. The coefficient $\gamma 00+u0k$ indicates the intercept at province *k* and γ indicate the slope for each predictor. The term e_{ijk} annotates the random effect for household *i*, ward *j* and province *k*.

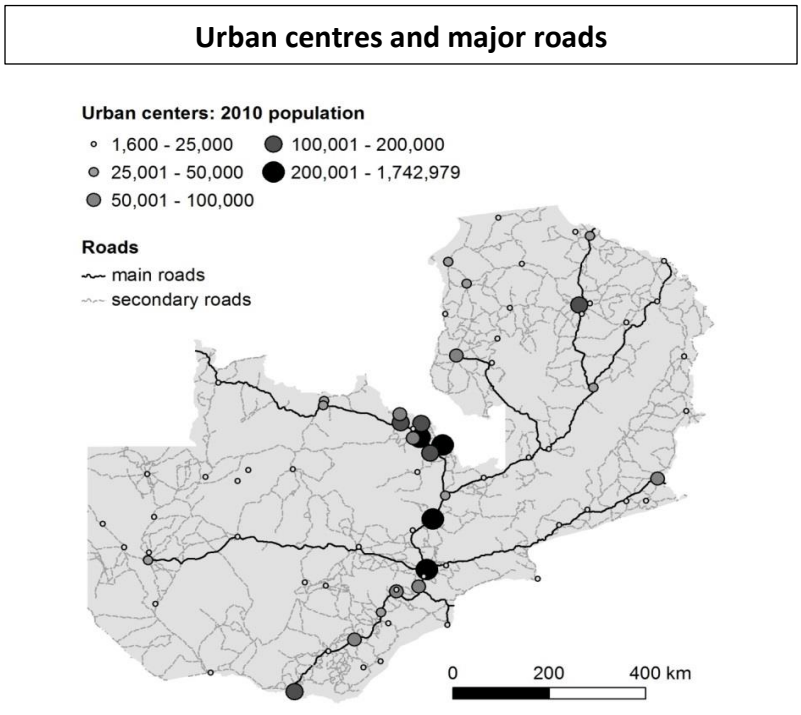
The second model is similar to the first, however, due to limitations with data handling the year variables have been dropped, and instead the relationship between education and farm size have been included in the regression. The year investigated is 2012, which is the most recent data available for the author. These models were regressed and used in order to infer graphical representation of predicted values for the relationship between distance travelled and quantity of fertiliser used. Simple linear regression and testing was used to identify the above models, see appendix B for regression results.

6 Empirical Analysis

Once the framework and background pertaining to the specific case of Zambia's regional disparities has been provided the results on the relationship between distance and socio-economic factors will be given. In the first section, an overall outline of general socio-economic disparities will be given. The two next sections, will then provide a descriptive analysis of the relationship between the level of education and access to market, followed by a similar analysis of access to level of capital, in this case value of productive assets, and market access. The final two sections will provide results based on a combination of descriptive statistics and mixed model regressions for both credit and fertiliser, respectively.

6.1 Descriptive analysis of regional disparities

Before proceeding with the analysis, it is relevant to clarify several definitions that will further strengthen the analytical framework. Several definitions have already been mentioned briefly, but not yet clarified in full detail.
The farms create three main groups that can be split into two additional groups based on spatial proximity to major infrastructural lines. Regarding farm sizes, the taxonomy is adopted from the definitions given by Sitko & Jayne (2014, p. 196), as this thesis similarly draws on data from the government's nationally representative survey data.

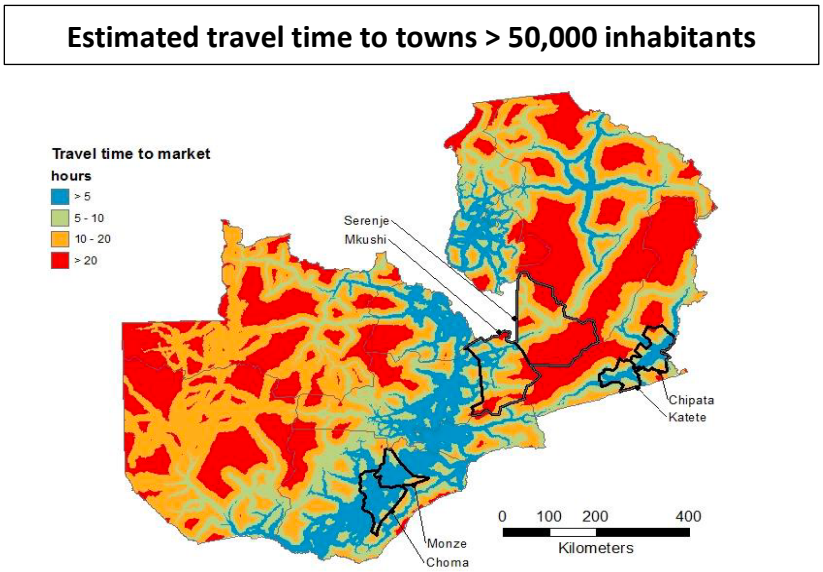


Map 6. 1 Source: Chamberlin et al. (2014, p.22)

Small-scale farmers are classified as those cultivating between 0.1–4.99 ha of land, whereas emergent, or medium-scale farmers, are those cultivating between 5–20 ha.

As pointed out, emergent farmers may own a lot more land than they cultivate (for further analysis, see Sitko & Jayne, 2014). Large scale farms are categorised as any household cultivating over 20 ha. The spatial outlay of the group supports division into two groups labelled *centre* and *periphery*, determined by their distance to the nearest market. Map 6.1 and 6.2 displays the relationship between the distance travelled and the market location. The definition for 'market' is taken from Chamberlin, Sitko, Kuteya, Lubungu, and Tembo (2014), here defined as towns of 50,000 or more inhabitants.

In this thesis, the core areas are defined by travel time to above-mentioned towns. Any area in which the general travel to the nearest town takes less than 5 hours can be classified as a core area, as it has relatively easy access to the market. Areas with travel times over 10 hours are classified as periphery areas, and areas with travel times between 5 and 10 hours as semi-peripheral/core area. Maps 6.1 and 6.2 show that the travel distance to market appears to correlate with the proximity to the line of rail and main roads (Chamberlin et al., 2014).



Map 6. 2 Chamberlin et al. (2014, p. 22)

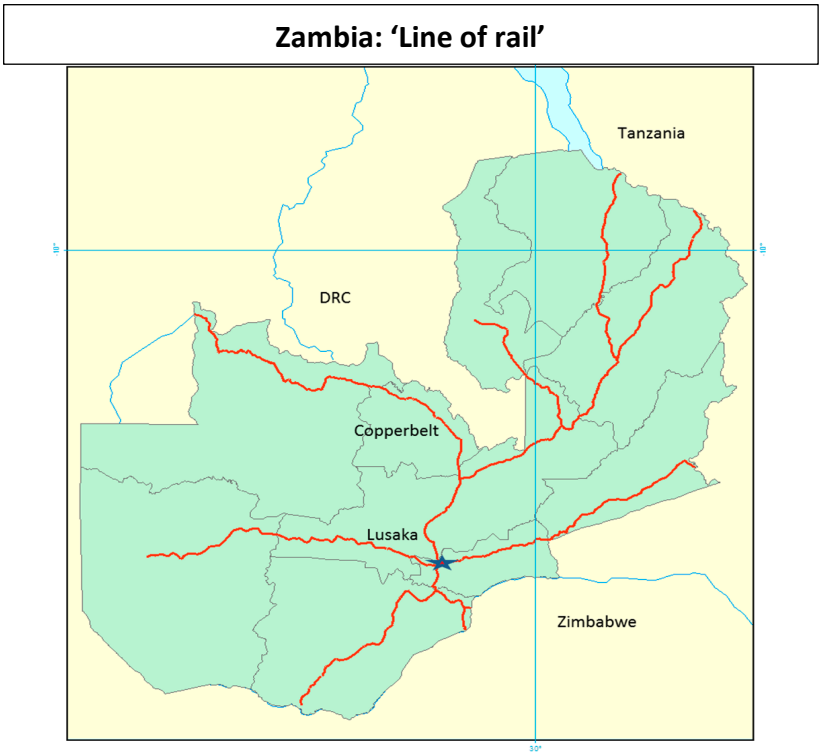
Table 6.1 provides a quick overview of the six different farming groups, sorted by their size and location. For clarity, the farming groups have been labelled according to their size (i.e. small, medium, large) and according to interaction with the market (i.e. self-reliant, market integrated). The term 'self-reliant' is used broadly, as it is assumed that no household operates completely outside of a market. However, the assumption implies that the more peripheral the location is, the greater the need becomes for self-reliance regarding some factors of production. Again, this varies with economies of scale: the larger the farming size (the assumption continues), the smaller the relative transport and, therefore, the smaller the transaction cost per unit. Households situated closer to the cores have greater access to markets; thus, costs are less to use the markets, hence the dependency rate on doing so is greater.

Table 6. 1: Farm Groups divided by geographic location and size

Farm size/location	Periphery	Core
Large scale: > 20 ha	Self-reliant LS farming	Market integrated LS farming
Emergent: 5-20 ha	Self-reliant MS farming	Market integrated MS farming
Small-scale: 0.1-4.99 ha	Self-reliant SS farming	Market integrated SS farming

Source: Own contribution

As mentioned, physical infrastructure the main type discussed and used for analysis purposes, in particular, rail and road. This is not to undermine the importance of other types of infrastructure, such as ICT. However, the contention is that digital infrastructure has limited effects on productivity enhancements. Peripheral areas are only partially integrated with one or the other form of infrastructure, as neither can substitute for the other. Comparing Map 6.2 and Map 6.3 below shows a very great similarity between the line of rail and major roads. In this case, and for analytical ease, proximity to the railroad and to major roads will not be differentiated in analysing data and declaring findings and conclusions. However, the historical effects of the Livingstone corridor (railway) and the development of land reforms have skewed the distribution of land and favoured settlers and large-scale land owners. Hence, most of the large-scale farms of Zambia lie in proximity to the North-South railway.



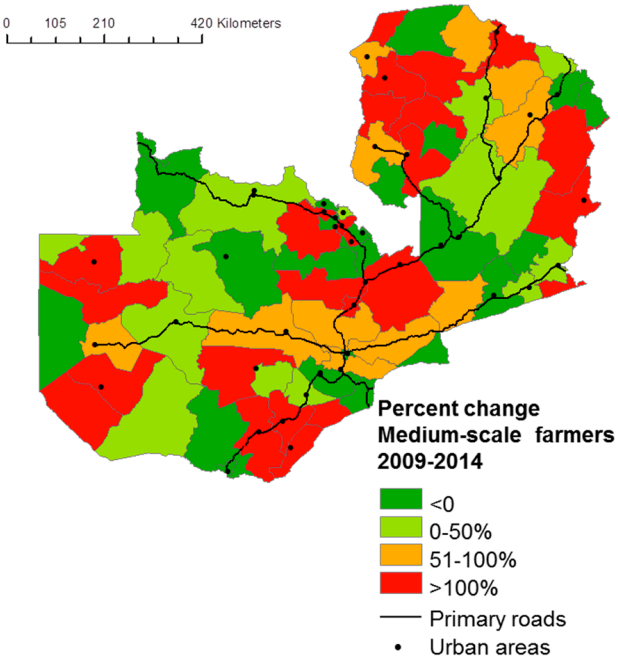
Map 6. 3: Source: Sitko and Chamberlin (2015, p. 876)

Previously indicated disparities in wealth are quite prevalent throughout most of Zambia, having largely taken shape in the last decade's growth spurts of medium-scale farms.

The bifurcated system of land administration, which divides state and customary land, has proven problematic for the small-scale farmers' ability to expand, as it sanctions Zambian urbanites and foreign investors acquiring land at the expense of displacing small-scale farmers (Sitko & Chamberlin, 2015). The 1995 Land Act grants the possibility of converting Customary land into Leasehold titles. However, this occurs without specifying 'socio-economic goals or objectives' (Sitko & Chamberlin, 2015, p. 873). A relatively uninvolved method of land conversion, the 1995 Land Act has detached land security and legal protection from traditional local residents and paved the way 'for manipulation by more powerful segments of society' (Sitko & Chamberlin, 2015, p. 873). This results in several cases of 'nonlocal' repossession of land through personal payments to traditional authorities and the growth of medium-scale farms in the core areas (Jayne et al., 2014; Sitko & Jayne, 2014).

Drawing on virtually the same data, as presented by Sitko and Chamberlin (2015) present a small account of the regional disparities. Map 6.4 shows the percentage changes in medium-size landholdings, in comparison to the total population of medium- and small-scale farmers. The likely inequities of land attainment by the urbanite farmer centre around the line of rail in a north-south dispersion. Map 6.2 shows that this is regarded as the area with the greatest market integration and where the conditions of factor endowments will most likely 'favor an agricultural-led commercialisation process' (Sitko & Chamberlin, 2015, p. 876). Centred around the trunk-road and the railway network, these areas represent the most lucrative investment opportunities for foreign large-scale investments. The large interest in land investments has resulted in greater land inequality in the districts of the Central, Copperbelt, Muchinga, Luapula and Northern provinces, where distance to market is smaller and rainfall more stable (Chamberlin et al., 2014; Sitko & Chamberlin, 2015). This ultimately results disparity in market access, seen in the possession of not only land but also assets, access to capital, fertiliser and education.

Change in number of medium-scale farmers in comparison to small and medium-scale population 2009-14



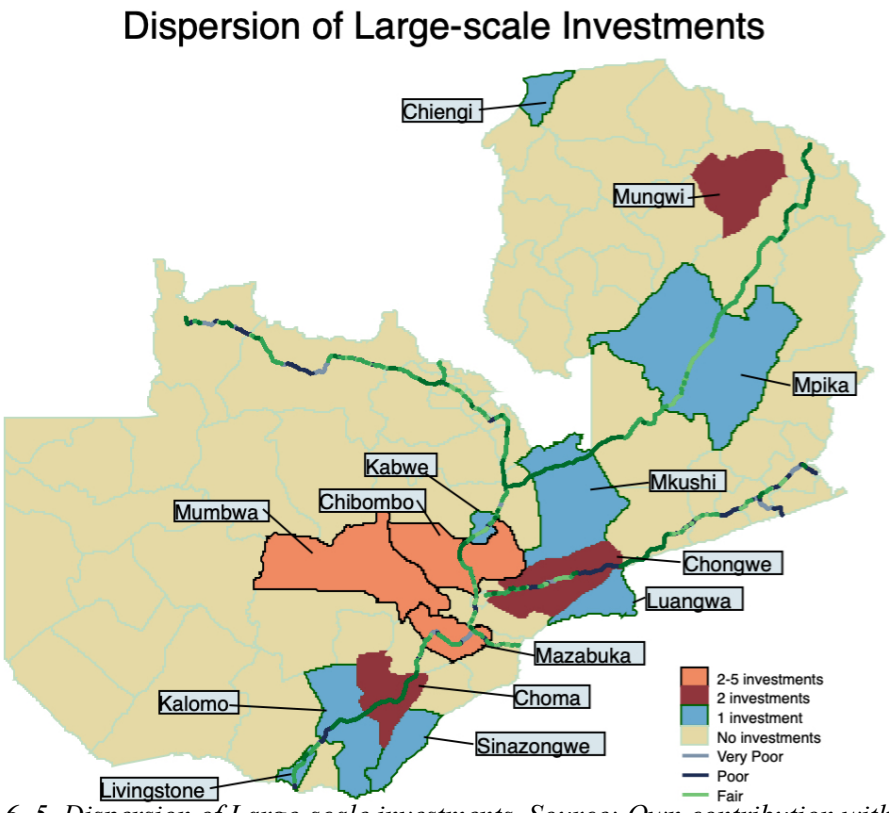
Map 6. 4: Source Sitko and Chamberlin, 2015, p. 87

As previously stated, most foreign large-scale investments are situated in areas around the centre. Map 6.5 represents the dispersion of reported large-scale investments throughout Zambia. A total of 32 investment projects in agriculture has been reported as currently active and confirmed by sources not connected to the media. As the map implies, investments largely cluster around the main T-roads going from southwest to northeast.

Further, the areas with the greatest concentration of investments are situated directly in the centre, in districts surrounding Lusaka. These findings support the general notion that large-scale investments are situated in areas with good infrastructure and good soil conditions.

The reported surge in large-scale agricultural investments has not had any direct negative impact on the small-scale farmer's productivity (Lay et al., 2018). Rather, it seems to increase that productivity, confirming the idea of positive spillover effects. However, the use of fertiliser among smallholders has declined in areas with large-scale farms. However, this could be attributable to the rapid increase in emergent farmers (Lay et al., 2018). As previously seen in map 6.4, medium-scale or emergent farmers have increased rapidly in the same areas in which most large-scale investments took place.

This could indicate that the emergent farmer seeks the same optimum conditions as the large-scale investors. As previously stated, Lay et al. (2018) found positive correlations for the coexistence of large and small-scale farmers. In fact, they observed that smallholders in wards with large-scale farms had greater asset value, generated a higher yield and harvested larger areas than wards with no large-scale farms.



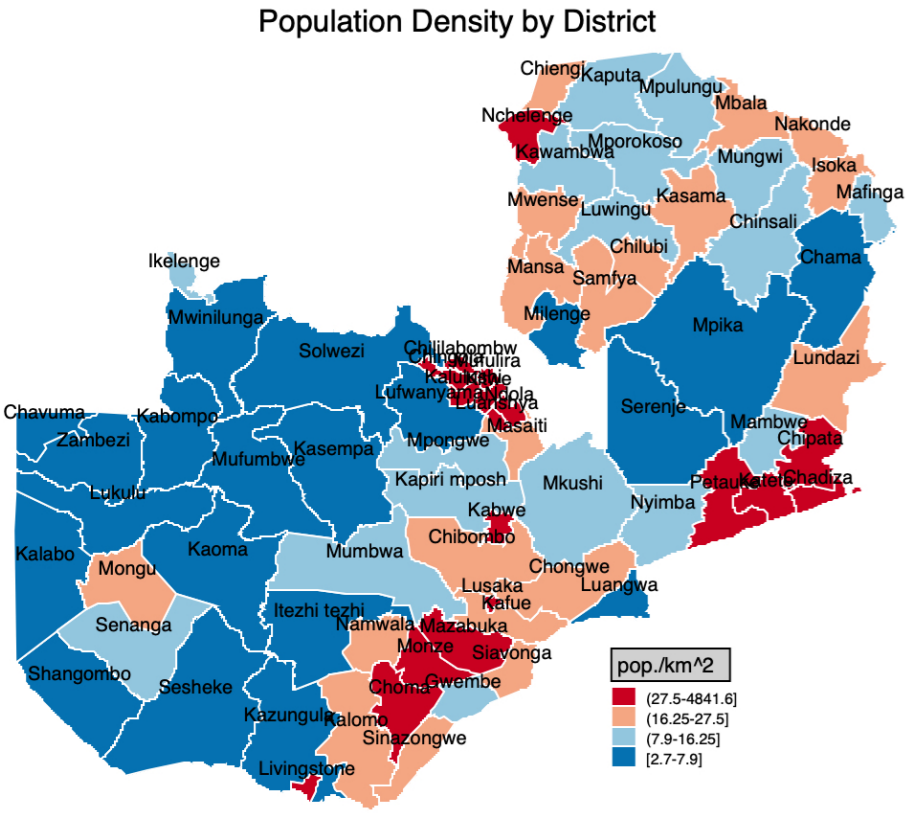
Map 6. 5. Dispersion of Large-scale investments. Source: Own contribution with data from The Land Matrix

Based on previous findings, it is suggested here that the reason for these differences between wards has more to do with large-scale farmers seeking out areas with the most favourable conditions, such as the greatest links to markets, which also provide benefits to the smallholder.

Furthermore, it is also assumed that farmers need readily available labour, probably more accessible in areas around the centre where population density is higher.

Higher population density not only provides readily available labour for the large-scale farms, as suggested by Lay et al. (2018). It also improves the conditions for a favourable network of knowledge sharing and co-dependency. It increases the use of fertiliser and other inputs through a greater common demand that ensures greater bulk delivery of these goods at a lower price per unit.

As seen in Map 6.6, the areas with the highest population density pertain to the central and southern districts, the eastern districts and particularly the northern districts in the Copperbelt province, where the mining sector predominates. It appears to agglomerate around the rail line and where large-scale farms are most prevalent. This indicates similar effects of greater opportunity due to greater access and lower costs as described by Krugman (1991) and Hillbom and Jenkin (2018).



Map 6. 6 Population density by district. Source: Own contribution with data from CSO 2010

Apart from lower input costs, associations have been found between spatial proximity to the centre, infrastructure and level of income. Table 6.2 shows the relationship between infrastructure and rural incomes. It is important to note, that incomes do not only pertain to farming incomes, but also includes off-farm salaries.

Table 6. 2: Total net income for households

Type of infrastructure	mean	p25	p50	p75
Main-road	13063.94	3802.185	7601.7	14625.37
No major infra	11130.53	3497.485	6621.251	12003.52
Trunk-road	219000	3341.415	6563.12	13971
Total	116086.3	3445	6841.255	13614

Source: Own contribution with data from RALS'12

Due to high skewness of observations, the quartiles have been reported in combination with the mean. However, the observations indicate that in general, areas with higher levels of infrastructure also have higher net incomes. This can be partially due to lower input costs and net incomes for product sold, due to lower transaction costs, and partially because areas with higher infrastructure are situated at the centre areas with higher population density, where the possibility for secondary incomes is greater and a higher rate of urbanite investors exists (please see previous discussed maps).

As seen from the table above, an apparent link seems to exist between the level of education, use of fertiliser and spread of advice. Districts with higher population density have higher average educational levels and higher numbers of people receiving advice regarding agricultural farming practices. This could indicate that farmers in general have greater combined 'gravity', in the sense that greater agglomeration attracts greater benefits, in terms of public services and lower costs in relation to buying inputs. Therefore, it is expected that most places with higher population densities correspond to areas with higher rates of observed loan credits, education and use of fertiliser. The exact relationship between the population density and access to markets is not clear. However, historically it would seem that the presence of the railway has meant greater influx of people.

6.2 Socioeconomic disparities on a spatial level

Research papers have long contemplated the ineptitude with which smallholders attempt to commercialise. Many suggest several reasons for this; however, the overarching theme of them all seems to be limitations on market entry, such as lack of capital, education, access to new land with adequate soil qualities, additional constraints imposed by greater competition in formal markets and inadequate institutions. Most do agree that infrastructure provides a vital lifeline for producers and for economic growth, but fail to compare the effects of its presence with the development of agricultural producers.

The section above reports several socioeconomic disparities that appear between the rural periphery and peri-urban centres. The historical presence of infrastructure has altered the path-dependency of Zambia's economic development and provided nearby regions with greater economic benefits.

This has changed the development of the agricultural sector and the nature of its producers. Several of the inhabitants in the central regions are better endowed in terms of land, capital and education. The existence of the 'Line of Rail' has ensured greater influx of capital and labour, resulting in higher population densities and more public goods, such as more complex infrastructure networks. In addition, the ecological zone wherein the line of rail is situated has also proven beneficial for agricultural productivity. Good soil quality and stable annual rainfall has meant that the output has generally been high and stable. It would seem, then, that the presence of the railway has shaped the development of economic activities around itself and opened new market opportunities. Establishing a greater infrastructural network to connect the peripheral areas to the market could potentially reshape the economic trajectories of the areas surrounding them.

Therefore, the following analysis is based on an interest to clarify the relationship between several factors that have been identified as crucial for efficient agricultural production and the distance to markets. The factors investigated follow the outline of the research question and are thus education, capital, credit and fertiliser, in that order.

6.2.1 Access to Education

Despite having a guaranteed right to education, Zambia's educational system ranks in the lower end of low- and middle-income groups, with a large proportion of its population having no more than a primary education. Around 27% of the Zambian population has either an incomplete primary education, or no education at all. Further, around 45% of the total population has an incomplete secondary education. In 2010 the annual dropout rate was at around 2% nationwide (Education Policy Data Center, 2019). Reasons for the high number of high-school dropouts include economic hardships, the loss of a parent/guardian, a requirement for agricultural work for the household and pregnancies among high-school students.

Access to education can lead to higher probability of commercialising and penetrating the formal markets. The geographic presence of education can lead to higher levels of productivity across different socioeconomic groups of farmers. Higher literacy levels lead to higher rates of adaptation and dispersion of new technologies and methods in areas where they are present (Weir & Knight, 2000). Furthermore, smallholders tend to rely more heavily on labour inputs from other members of the household, in particular in the Western provinces where agricultural production is more extensive (Burke et al., 2011).

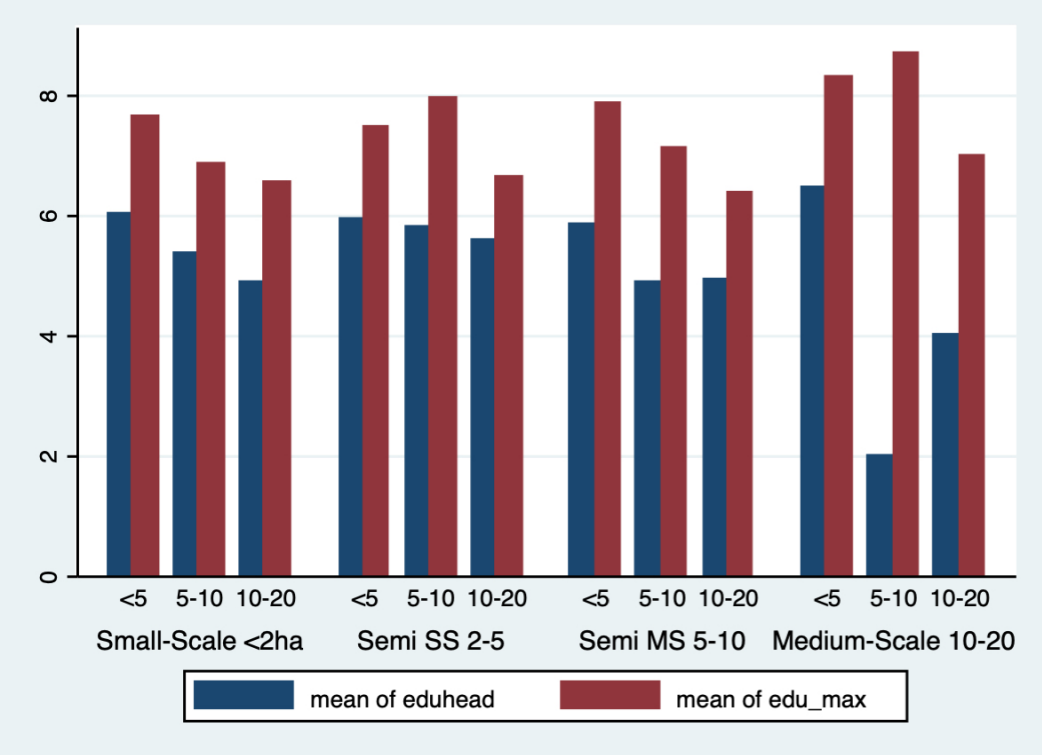


Figure 6. 1 Max. education and education of household-head in years, based on distance to market in hrs. Source: Own contribution with data from RALS'12

In general, Zambia has experienced a nationwide increase in the average level of education. Figure 6.1 displays the average educational level of the head of a household and highest educated household member grouped by distance to market and size of land holding. As shown in Figure 6.1, the average maximum educational level in a household is approximately 1.5 years higher than the average level of education for the head of the household. This could indicate an upward trend in the general educational level for newer generations. Conversely, similar disparities between the supposedly younger generations persist.

On average, the small-scale farmers have lower levels of education in comparison to the medium-scale farmers. Moreover, the average years of education are negatively associated with the reported distance to market. This trend is best seen in the average years of education between farm groups below 2 ha and farm groups between 5 ha and10 ha. Here, the average education level drops by approximately 1.5 years between groups with less than 5 hours to market and groups with 10–20 hours to the nearest market. Thus, distance, in the form of transport time, affects the availability or use of educational benefits across all socioeconomic groups. The large difference between means with respect to education of the head and the maximum educational level for medium-scale farmers with 5–10 hours to the market is noted; however, the reason for this is not apparent. A suggestion could be an extensive increase in educational availability in areas with a large proportion of farmers cultivating between 10 to 20ha, between central peri-urban and peripheral areas. The travel time reported does not account for the mode of transport used by the respondent. However, many farmers in the lower segments use as their main method of transport either rudimentary animal-drawn carts, bicycles or on-foot, whereas mostly the urbanite farm investors who own cars.

Figure 6.2 also displays the average educational level per household but based on the observed infrastructural level within the relevant district.

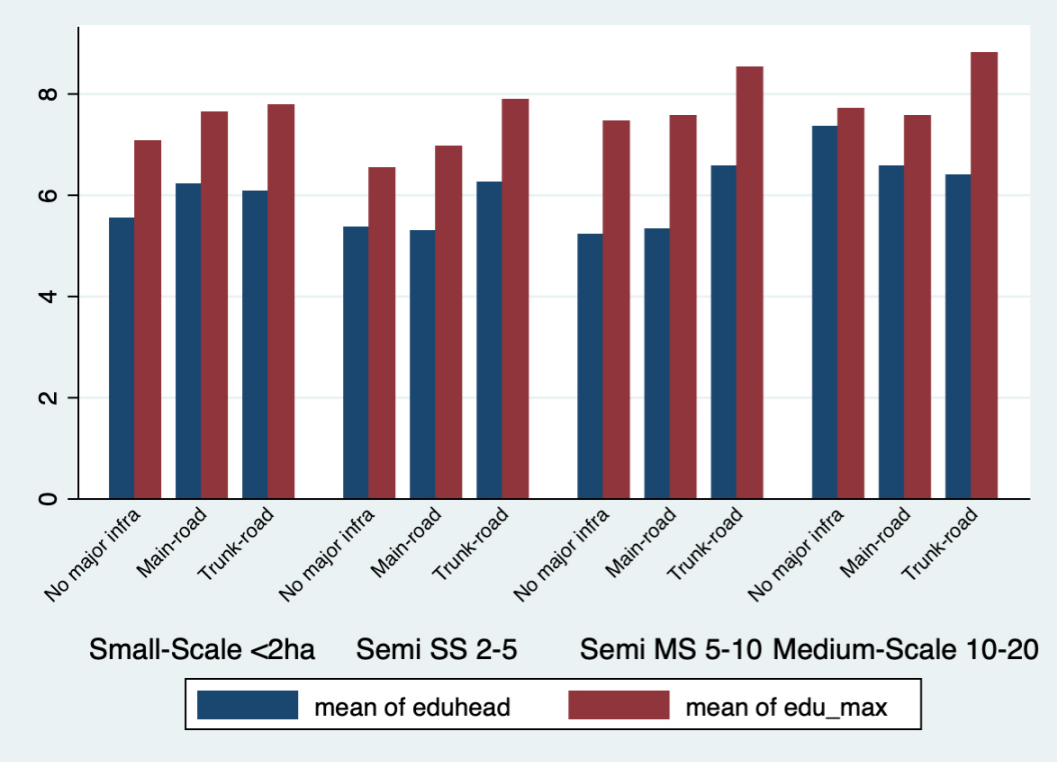


Figure 6. 2 Max. education and education of household head, in years, based on level of infrastructure. Source: Own contribution with data from RALS'12

As observed in figure 6.2, a general positive correlation exists between the observed level of education and the observed level of infrastructure among smallholders. This suggests that the distance travelled to market and the level of infrastructure correlate as well. This suggests that greater infrastructure connecting the peri-urban areas is vital for providing public goods, such as education.

6.2.2 Capital Access

Greater capital endowments for certain groups are likely to result in greater inequality, if the return on capital is greater than the overall growth of the economy. In terms of direct farm inputs, capital has an additional effect on the efficiency of labour and, thus, on the output produced. Productive assets are most likely bought in a common market where prices theoretically could be coordinated. Despite unison market prices, the access to such markets could affect the indirect costs of purchase, in the form of time spent and transportation costs. This would mean creating greater divergence between farming classes. Furthermore, areas with greater diffusion between households could also affect practises of using certain productive assets simply due to a lack of dispersion of knowledge or know-how, as Weir and Knight (2000) observe.

Table 6.3 shows the distributed value of productive assets by farm groups and by infrastructural linkage for a given district. Districts are categorised based on the observed infrastructure within their borders. 'Trunk roads', normally denoted by a 'T' on maps, refers to the interterritorial road system that facilitates corridors to foreign markets. The trunk roads run north to south, through the centre, and east from the centre. The road system largely connects Zambia with Southern and Eastern Africa, as well as Congo, omitting large parts of the border shared with Angola and large areas of the western provinces. The main road connects major cities and provinces.
Looking at the average values of productive assets, a clear distinction between farm sizes arises, as would be expected. However, more interestingly, a clear distinction between the observed types of infrastructure in a district and the average value of assets can be identified, with the exception of the distinction between the 'No-infrastructure' and 'Main-road' categories for farm-groups between two and ten hectares. Furthermore, an increasing gap between the mean and the median, going toward areas with trunk-road infrastructure, can be observed. This could indicate greater inequality in more well-integrated areas, which corresponds to the findings of Sitko and Chamberlin (2015, p. 878).

Districts with trunk-road infrastructure, largely situated around centre areas of the country, can be described as having a much larger asset base than farmers situated in areas with sparse infrastructure. For small-scale farmers cultivating less than two hectares, this constitutes a 99.6 percent difference in value for assets—a significant increase in comparison to districts with only main-road networks. For small-scale farmers, between two and five hectares, and medium-scale, between five and ten, the pattern is similar, with percentage differences of 217 and 38.9 percent, respectively.

Table 6. 3: Value of Productive Assets (ZMK): By Farm-group and Market access

Farm size categories	district categorised on road network		
	No major infrastructure	**Main-road**	**Trunk-road**
Small-Scale <2ha	4119.636	6410.844	17905.97
Mean/Median	1190	1000	1900
Semi SS 2-5ha	11009.13	10372.91	34952.57
Mean/Median	3215	2297.5	5675
Semi MS 5-10ha	30803.47	26080.18	42793.56
Mean/Median	10189	9600	18080
Medium-Scale 10-20ha	42008.07	60156.67	83100.46
Mean/Median	34800.17	39335	49855

Source: Own contribution with data from RALS 12

The contraction in value differences could be explained by an increase in buying-power as land size increases wealth. However, the percentage difference does slightly increase to 97.8 percent for farmers cultivating more than 10 ha. The causes of this increase in the gap between farmers cultivating more than 10 ha in the less well-integrated districts are unclear. One suggestion could be that it is an effect of the urbanite Zambian investor situated around the central areas, where little agricultural production takes place (Sitko & Jayne, 2014).

As districts were mainly categorised based on the type of infrastructure and not the amount, the value of productive assets for farm groups between 2 ha and 10 ha in the main-road districts, could be due to the relatively low level of infrastructure in the western region. Here, distance to nearest market is relatively high for large parts of the area (see Map 6.2) and land scarcity is low (Sitko & Chamberlin, 2015). This would result in areas with larger farm sizes and fewer productive assets. Similarly, there might be areas with high levels of infrastructure, not for the service of the agricultural sector but for the service of the mines, such as in the northern region. In summation, the overall picture that emerges suggests that there a indicators of regional disparities in the value of productive assets among smallholders.

6.2.3 Access to credit

With relatively low levels of wealth and small profit margins in a volatile and exposed profession, access to credit is paramount for the small-scale agriculturalist. As most smallholders do not access loan facilities from conventional banks, as seen in table 6.4, agricultural credit in the form of micro credit, or input credit, is imperative to secure higher yielding seeds, new equipment, fertiliser and increasing the land hold.

Outgrower-schemes, by far the most frequent method of attaining credit for agricultural inputs, have shown a small decline in usage of 1.5% between 2004 and 2012 (see table 6.4). A study by Deininger and Byerlee (2011) indicates that despite lower yields, efficiency among smallholders is not necessarily lower than that of large-scale producers. Smallholders' costs have been found to be lower or equal to neighbouring large-scale producers. This contributes to the argument that broad-based agricultural growth is viable. Moreover, generating broad-based growth would increase smallholder's income by a factor of between 2 and 10, compared to what they could earn as wage labourers. Furthermore, the authors argue that contracting farmers and using outgrower programmes can lead to greater dispersion of knowledge and technologies between large- and small-scale farmers, broadly increasing productivity and generating the possibility for upward social mobility—however, only for those who have land. This hinges on the institutional systems' competence and ability to provide equal and fair land rights, about which recent studies are quite ominous.

Table 6. 4 Loan/Credit Type in Percentages and Frequencies

	year		
Source of loan / credit	2004	2012	Total
Government-run program	71	73	144
	10.35	4.66	6.40
Commercial bank	8	22	30
	1.17	1.41	1.33
Farmers' union or cooperative	3	165	168
	0.44	10.54	7.46
Micro credit institution / community credit scheme	37	43	80
	5.39	2.75	3.55
Out-grower scheme	455	1015	1470
	66.33	64.86	65.30
NGO / faith-based organization / church	54	16	70
	7.87	1.02	3.11
Friend/relative/informal moneylender (e.g. kaloba)	51	224	275
	7.43	14.31	12.22
Company leasing equipment to own (e.g. Rent to Own)	0	7	7
	0.00	0.45	0.31
Other (specify)	7	0	7
	1.02	0.00	0.31
Total	686	1565	2251
	100.00	100.00	100.00

First row has *frequencies* and second row has *column percentages. Source: Own contribution with data from SS04 & RALS12*

Sadly, because outgrower schemes have documented positive effects on the income of the smallholder, such a decline can have significant effects for equity among small-scale producers, particularly in combination with a rapidly rising population.

Smoothing out fluctuations in yield and price can be vital for the survival of small-scale producers. The use of lump increases in capital can assist in expansion and productivity, thus improving income and reducing long-term vulnerability. Small-scale financing, or micro financing (MFI), could lead to the opportunity for upward social mobility. However, for most of SSA, access to MFI is still very limited. As Table 6.4 shows, the dispersion of credit loans and MFI in Zambia made up only about 5.4 percent of total loans and credit types in 2004, and 2.75 percent for 2012. Despite declines in both outgrower schemes and MFIs, there has been a generally upward trend in lending. In 2004, approximately 12.7 percent of the sampled population received a credit in some form. In 2012, the amount of financing had increased to 17 percent. However, as financing is essentially debt creation, repayment is expected. Debt can provide great opportunities for expansion and security. Yet, many small-scale farmers naturally have very low product margins with little turnover and operate in a market with many negative external forces. This means that many small-scale agricultural producers can risk encountering great difficulties settling their debt (Hulme, 2007). In addition, Hulme (2007) reports that for many developing countries, the poorest proportion of the population is rarely offered MFI, most likely due to the additional risk of being below, or at best close to, the absolute poverty line, in which case an enterprise loan for farm production is rarely sufficient, relevant or even urgent.

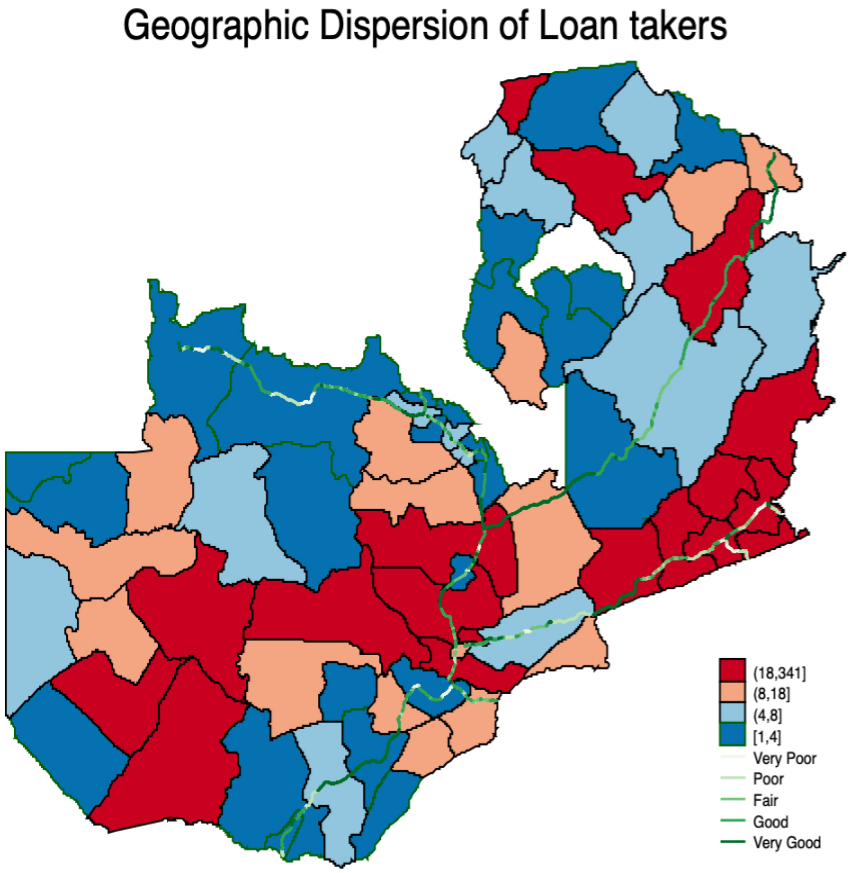
Table 6. 5 Did household borrow money or obtain a loan (cash/in-kind) for the period?

	2004		2012	
Farm-size category	Yes	No	Yes	No
Small-Scale <2ha	353	3381	480	3579
	9.454 %	90.546 %	11.826 %	88.174 %
	51.458 %	73.040 %	30.769 %	31.771 %
Semi SS 2-5ha	267	1045	744	5313
	20.351%	79.649 %	12.283 %	87.717 %
	38.921%	22.575 %	47.692 %	47.164%
Semi MS 5-10ha	52	173	296	2071
	23.111%	76.889 %	12.505 %	87.495 %
	7.580%	3.737 %	18.974 %	18.384 %
Medium-Scale 10-20ha	14	30	40	302
	31.818 %	68.182 %	11.696 %	88.304 %
	2.041 %	0.648 %	2.564 %	2.681 %

Source: Own contribution with data from SS04 & RALS 12

Yet, Table 6.5 shows that the majority of loan-takers in 2004 were small-scale famers, with land-holdings below 2 ha. In 2012, a shift in focus appears, away from small-scale farms, and more medium-scale farmers have gained entry, as the proportion cultivating between 2 and 5 ha financed their agricultural productivities with loans. As previously discussed, a documented rise in urbanite medium-scale farmers could provide an explanation for the relative decline in MFI and outgrower schemes between 2004 and 2012 as they possess greater wealth and

therefore not intended for MFI, therefore using more commercial options. If such is the case, it indicates that a general proportion of the loans are taken in the central areas and not the periphery. Note that for table 6.3 we have several observations for the same entry hence the proportion of non-loan takers seems excessively inflated.



Map 6. 4. Source: Own contribution with data from RALS'12

As Map 6.5 shows, the majority of loans in 2012 were undertaken largely on a southwest-northeast diagonal. This follows the line of the primary M9-road (not displayed on the map) going from Lusaka and westward to Kaoma, and on through Mongu, toward the border of Angola; along the trunk-roads (seen on map 6.5) leading north toward Mbeya (Tanzania); and north-east to Chipata, this last considered a vital trading corridor for Zambia. Surprisingly, the number of loan-takers is relatively low for the southern districts around Livingstone, an area with high percent changes in medium-scale farmers (see Map 6.4). This concludes that there to indicators of great regional as well as socio-economic disparities among smallholders with regards to the use of MFI.

6.2.4 The use of fertiliser

This section explores the relationship between reported distance to point of collection for fertiliser and the cost of acquiring it. While acknowledging that regular principles of economies of scale have an effect on price, this section still intends to show that distance, in this case in the form of kilometres, has an impact on price, as well as the amount used for the smallholders.

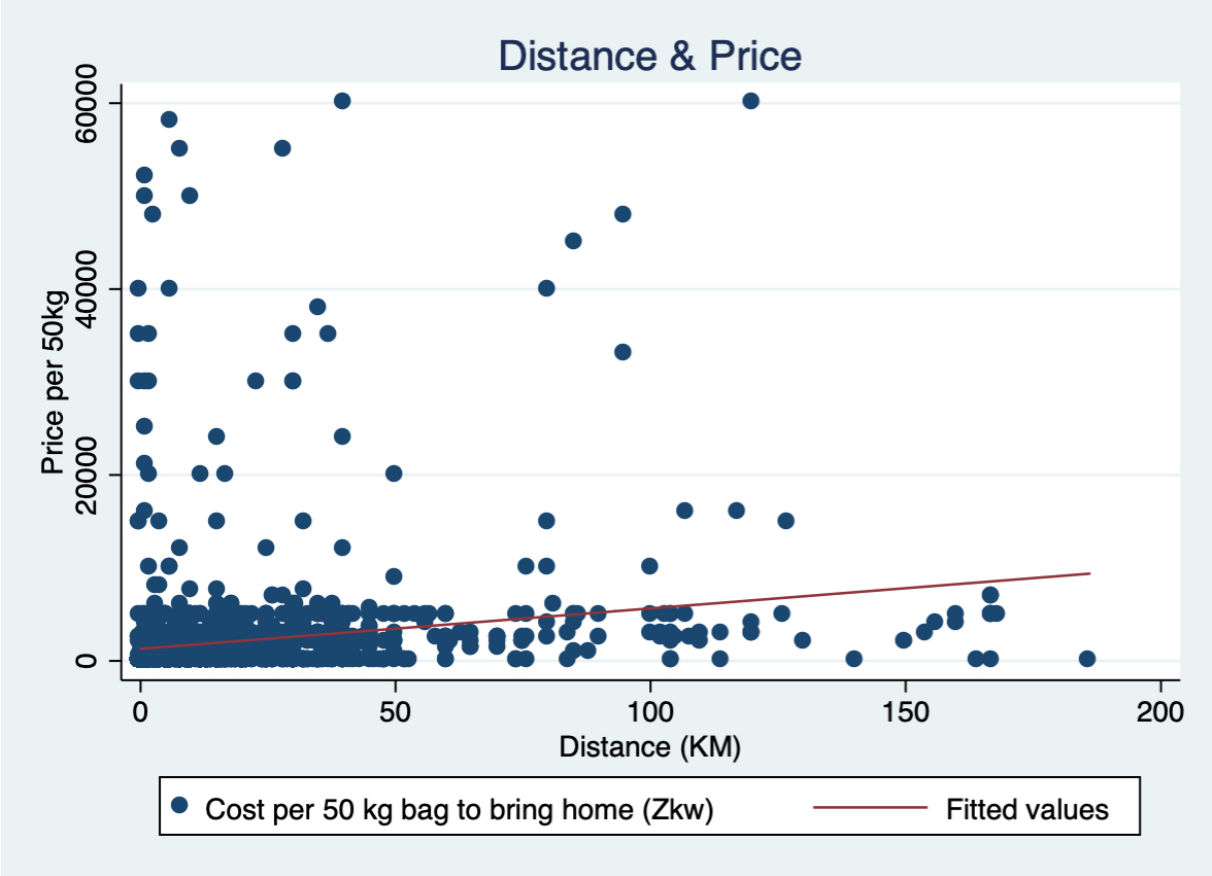


Figure 6. 3 Scatterplot Price and Distance. Source: Own contribution with data from SS'01, SS'04 & SS'08. Price has been multiplied by 1000.

Figure 6.3 shows the price per 50 kilograms of both basal and top-dressing fertiliser from the years 2001, 2004 and 2008. Although not strong, there is an observable correlation between distance and price. As the distance does not distinguish observations such as road type, mode of transport, proximity to agricultural neighbours or size of cultivated area, it is difficult to describe the exact nature of this relationship. However, for the observed values, it would seem that distance does affect prices.

If greater distances lead to greater prices, then the cost of acquiring the fertiliser must also be optimised. With regard to transportation, the most direct way of decreasing marginal costs is through increasing quantity.

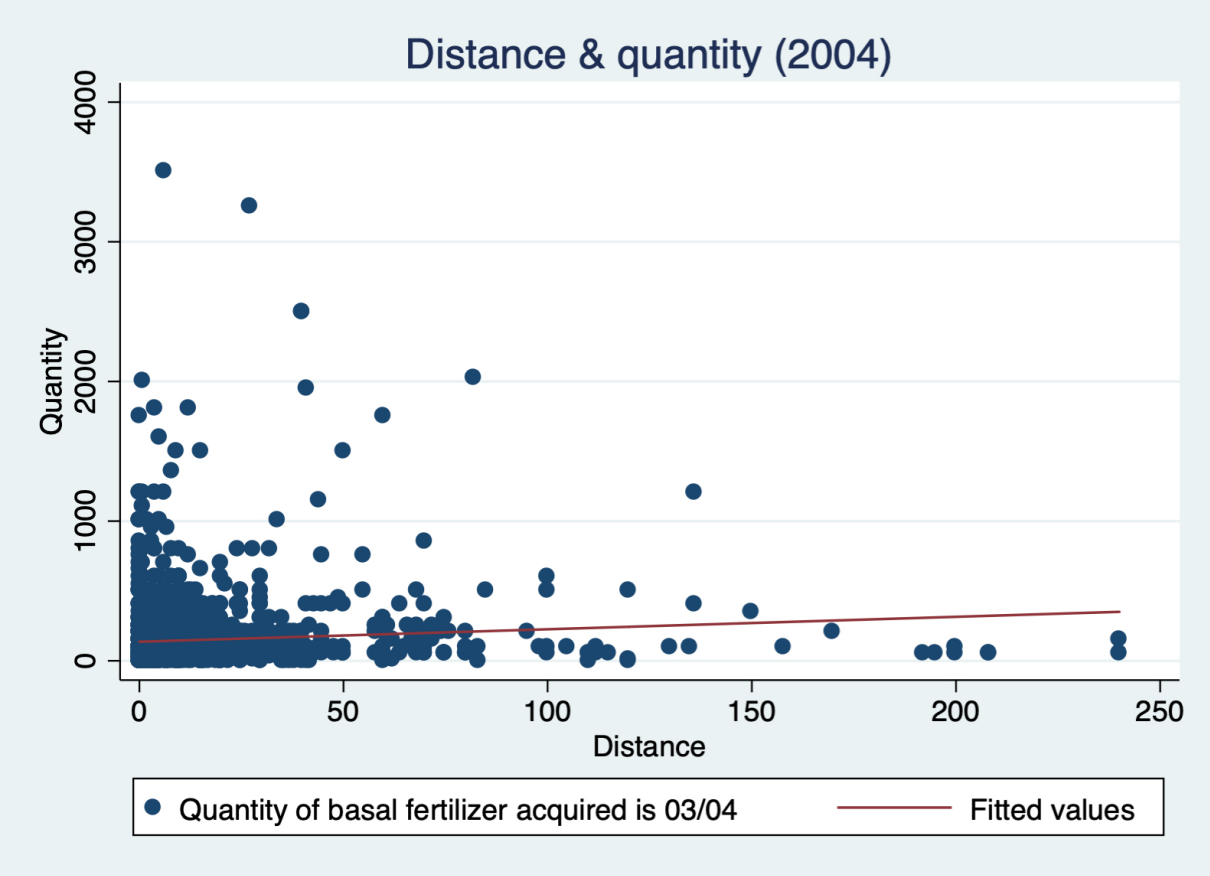


Figure 6. 4 Scatterplot distance and quantity. Source: Own contribution with data from SS'04. Quantity is reported in kgs.

Figure 6.4 shows that as distance increases, so does the amount of fertiliser acquired. Despite that apparent correlation, it might not be particularly strong, probably due to other factors affecting the quantity as well. As mentioned above, it does indicate that a need for efficiency is prevalent among smallholders in Zambia. This would also mean that capital-poor smallholders might not be able to purchase if the distance to the market is too far, as the costs are too great in comparison with those for more capital-strong producers, unless they either buy in bundle for several seasons at the time, or with other smallholders, in order to decrease costs per unit.

Furthermore, the same logic should apply for subsidised inputs such as the input supported fertiliser (FISP). Despite costs being lower, acquiring FISP fertiliser still requires a contribution payment by the farmer. Many small-scale farmers can therefore not exploit the benefits of government or organisationally sponsored input programmes, due to the marginal costs.

Figure 6.5 shows the quantity of FISP and the distance. As distance increases, the amount of fertiliser acquired increases as well. As previously mentioned, only 27.4 % of farmers with land holds under 4 ha received FISP fertiliser (Jayne et al., 2011). Looking at the potential correlations between price, amount and distance, it would seem that farmers with smaller land-holdings generally require lower quantities of fertiliser.

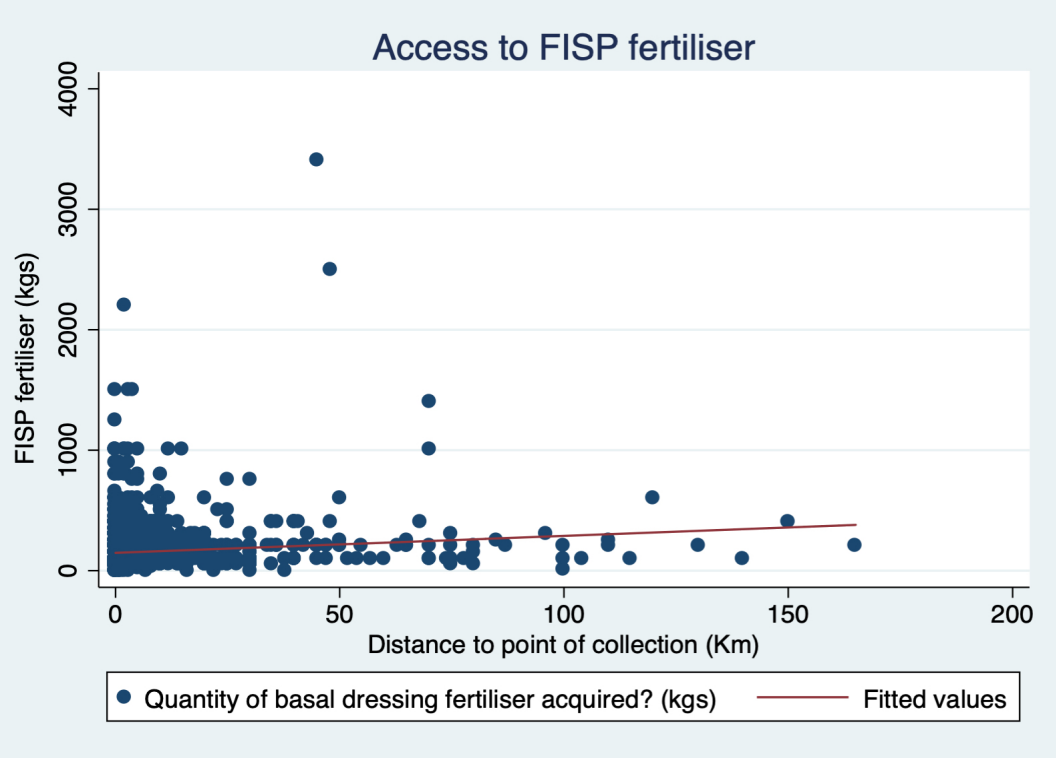


Figure 6. 5. Scatterplot, quantity of FISP-sponsored fertiliser and distance. Source: Own contribution with data from RALS'12.

Thus, for economic reasons, they find it not viable to acquire fertiliser if the distance to the collection point is too great. These findings indicate that the 70% of farmers cultivating less than 5 ha of land do not receive FISP fertiliser due to the costs associated with acquiring it, here under transport costs.

Although costly for the small-scale producer to acquire, Burke, Hichaambwa, Banda, and Jayne (2011) demonstrate that under the right conditions, fertiliser use is positively associated with higher profits. Still, they also find evidence of agricultural producers who do not see positive returns of their fertiliser use. Burke et al. (2011) suggest that this could indicate poor management practices, late availability of fertiliser, or use in areas with poor soil conditions. However, they also find that several other practices can enhance productivity without the use of fertiliser. Relying on regression analysis, they observe that several other tillage methods, such as ploughing, ripping and field rotation, show signs of raising gross margins and reducing production costs.

Summing up, fertiliser use may contribute to higher gross margins under the right conditions. However, the application of fertiliser alone may not ensure profitability of agricultural production. Employing several other more mechanical techniques and methods can ensure even

greater profitability among smallholders, but his would require the dispersion and implantation of such techniques.

Taking into account that data used was highly skewed, and in many cases difficult to manipulate, useful models for fertiliser, was found. Firstly. Correlating distance and use of fertiliser across the observed number of years from the SS and RALS surveys in a mixed model, or hierarchal linear model we get the following table. Fr02 denotes reported distance travelled in km, fr04 denotes quantity of fertiliser in kgs and fertch is the source categories.

Table 6. 6: Fertiliser quantity by year and source

Mixed-effects ML regression — Number of obs = 16,263

Group Variable	No. of Groups	Observations per Group Minimum	Average	Maximum
prov	10	127	1,626.3	3,992
id	72	3	225.9	1,201

Wald chi2(12) = 2022.72
Log likelihood = -79188.282 — Prob > chi2 = 0.0000

fr02	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
year						
2001	0	(base)				
2003	-4.731497	1.090532	-4.34	0.000	-6.868901	-2.594093
2004	-4.031709	1.112588	-3.62	0.000	-6.21234	-1.851077
2007	.5932009	1.006915	0.59	0.556	-1.380317	2.566718
2008	.8650887	1.021945	0.85	0.397	-1.137887	2.868065
2012	-1.926018	.9596799	-2.01	0.045	-3.806956	-.0450799
fr04	.0050614	.0018825	2.69	0.007	.0013717	.0087511
fertch						
FRA loan	0	(base)				
Other	1.992027	1.034921	1.92	0.054	-.0363802	4.020435
Direct exchange/barter	.753759	2.605696	0.29	0.772	-4.353311	5.860829
Cash purchases	18.88546	.6537679	28.89	0.000	17.60409	20.16682
fertch#c.fr04						
Other	.0040254	.0044552	0.90	0.366	-.0047066	.0127573
Direct exchange/barter	-.0040641	.0126179	-0.32	0.747	-.0287947	.0206666
Cash purchases	.0103143	.0021019	4.91	0.000	.0061946	.014434
_cons	8.437308	1.679713	5.02	0.000	5.145132	11.72948

Own contribution with data from SS'01, '04, '08 & RALS'12.

	df	chi2	P>chi2
fr02			
fertch	3	965.38	0.0000
year	5	56.67	0.0000
fertch#c.fr04	3	25.97	0.0000

Source: Own contribution with data from SS'01, '04, '08 & RALS'12.

Table 6.6 shows, most interestingly, that despite scepticism regarding the effects of agricultural policies, there has generally been a decline in the distance travelled for each additional unit of fertiliser between 2001 and 2012. With the exception of the years 2007 and 2008, where distanced increased briefly by 0.59km and 0.87km travelled for each additional kg of fertiliser bought. Further, the table also indicates that the distance travelled is significantly longer than other sources of fertiliser. Figure 6.6 gives a graphical representation of the predicted distance travelled per unit of fertiliser bought.

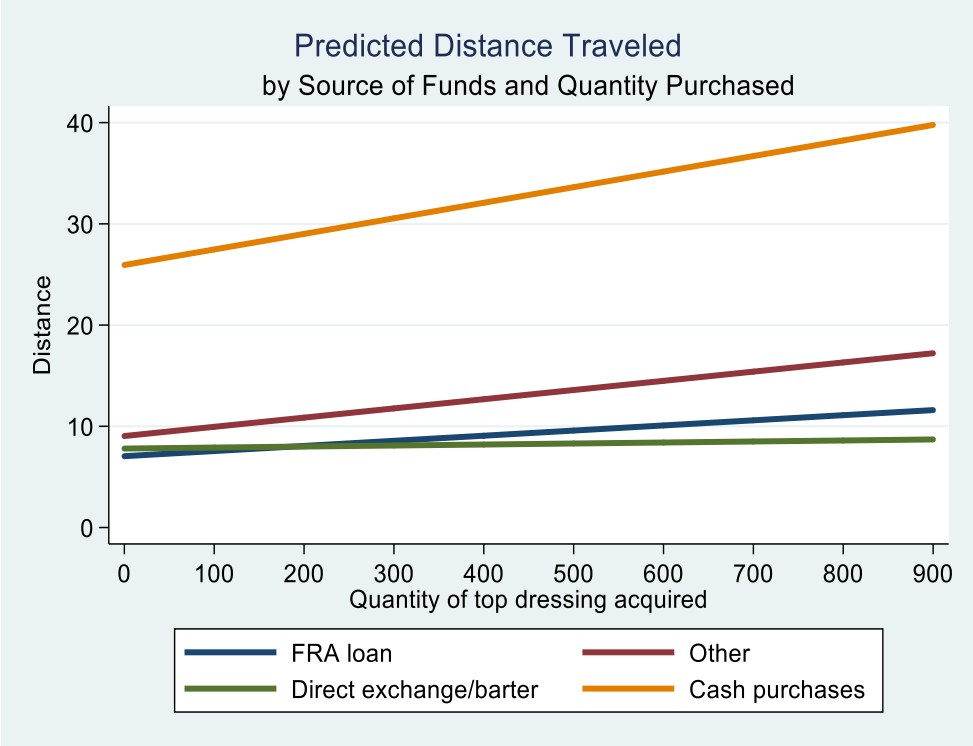


Figure 6. 6. Predicted distance travelled. Source: Own contribution with data from SS'01, '04, '08 & RALS'12.

As can be seen from the graph, there is a sharp correlation between distance travelled and amount purchased for households acquiring fertiliser via cash purchases. This could indicate one or more things. First, there is a greater willingness to travel further distances if amount is of fertiliser required is high. This means that farmers with larger areas to cultivate are more prone to travel further to acquire larger amount of fertiliser from the market. Second, the weak correlation between Distance and quantity of FRA supplied fertiliser indicates that farmers using the FRA supported option in general does not travel very far. This could indicate that

either the FRA suppliers are well integrated within all regions or, more likely, that farmers not situated within 10–11km distance of an FRA supplier simply omits to acquire fertiliser from this source. Trying to infer more about the relationship between distance travelled and use of fertiliser, we create a new mixed effects model, presented in table 6.7.

Table 6. 7: Fertiliser 2012, by source, farm size and education. Mixed Effects model

Distance travelled (km)	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Fertiliser q.	0.002	0.001	1.77	0.077	0.000	0.004	*
Fertiliser available (base)	0.000	.	.	.	.	.	
Fertiliser not available	-0.418	0.415	-1.01	0.314	-1.231	0.395	
Fert source: Other	-0.568	0.666	-0.85	0.394	-1.873	0.737	
Fert source: Cash Purchases	9.525	1.579	6.03	0.000	6.430	12.619	***
Area cultivated (ha)	0.399	0.307	1.30	0.194	-0.203	1.001	
Other sources*area cultivated	-0.614	0.292	-2.10	0.036	-1.186	-0.041	**
Cash purchases*area cultivated	1.067	0.137	7.80	0.000	0.799	1.335	***
Cash purchases *Education	0.115	0.106	1.09	0.277	-0.092	0.323	
Other sources *Education	-0.100	0.131	-0.76	0.445	-0.358	0.157	
education	0.158	0.061	2.57	0.010	0.037	0.278	**
Education*area cultivated (ha)	-0.046	0.026	-1.73	0.084	-0.098	0.006	*
Constant	2.489	0.527	4.73	0.000	1.457	3.521	***

Mean dependent var	7.784	SD dependent var	11.345
Number of obs	13405.000	Chi-square	.
Prob > chi2	.	Akaike crit. (AIC)	97750.674

**** p<0.01, ** p<0.05, * p<0.1*

Source: Own contribution with data from RALS'12.

Despite several of the values not being significant, we do however see a more detailed relationship between size of land hold and area cultivated. This relationship is better presented in the figure below.

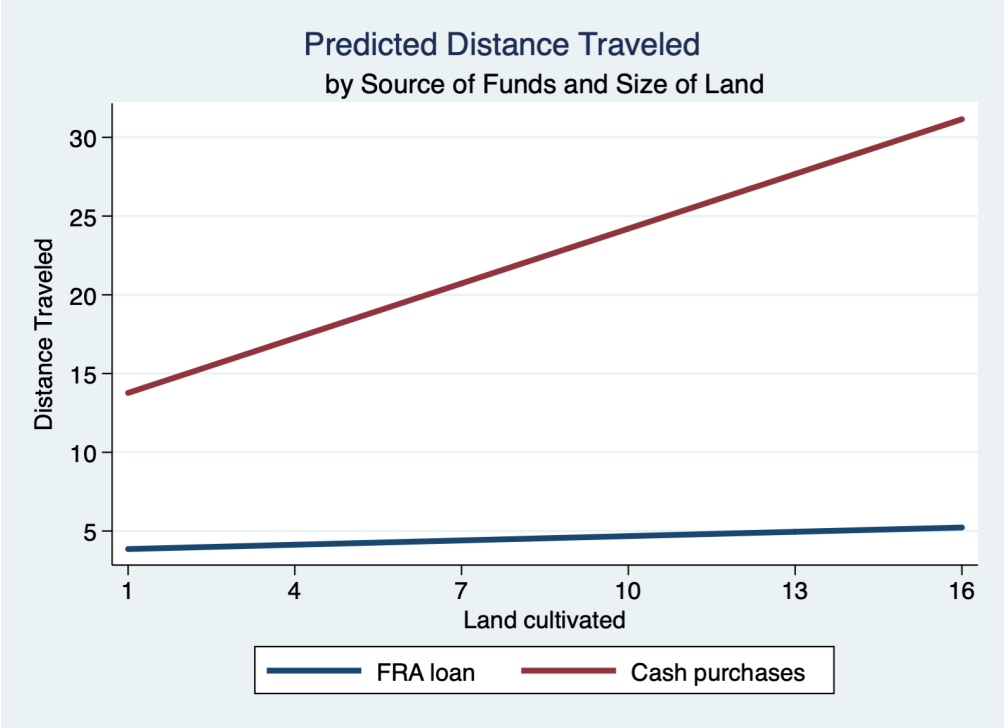


Figure 6. 7. Predicted distance by farm size. Source: Own contribution with data from RALS'12.

As can be seen from figure 6.7 there is a strong correlation between distanced travelled and size of land hold for cash purchases, whilst there is almost no relationship between FRA supplied fertiliser and distance travelled. This indicates that there is little peripheral integration of government supplied fertiliser. And that most small-scale producers with land holdings below 5ha and who acquires fertiliser via cash do not generally travel more than 18km to the nearest point of purchase.

Thus, indications of limited integration of fertiliser support in the periphery and greater use of fertiliser among educated and larger farms have been found. Suggesting that there still is a dire need for a greater effort in support of smallholders.

7 Conclusion

This thesis was written with the intention of applying spatial observations for smallholders and comparing and contrasting socioeconomic differences in relation to infrastructure across districts in Zambia. Its main purpose was to challenge and shift the current focus in agricultural development toward the effects of distance to markets and to neighbours, and the potential for broad-based agricultural transformation. The thesis sought to determine the winners and losers of greater integration through the establishment of infrastructure. The thesis aims at analysing the effects of large-scale farming, education, micro-finance and access to inputs and outputs in spatial contrast. The overall findings of this thesis are that benefits of land availability in peripheral areas are, for smallholders outweighed by the negative effects of limited access to markets. Mainly the inaccessibility to capital, inaccessibility to education and a lack of dispersion of knowledge for smallholders. This is mainly seen as regional disparities of studied inputs between the peri-urban centre and the peripheral region. Further, in light of the most recent development plans for Zambia and in light of the findings of this study, this thesis suggests that a positive impact of greater integration through infrastructure can be found with regards to the possibilities for commercial production among smallholders.

Guided by the aim of the thesis, the research sought to find answers to questions concerning the socioeconomic disparities and the potential for new opportunities given to or seized by smallholders between different districts of Zambia, comparing their location, level of infrastructure, population density and other factors pertaining to their access to market. The questions that guided this thesis pertained to the relationship between distance/access to market and inputs, being: Education, productive capital assets, credit products and fertiliser.

Evidence was found that hints at a need for greater integration of rural areas and particularly of rural producers. This was mainly evidence that suggested socioeconomic disparities between smallholders of different districts, in particular between districts at the Line of Rail and districts in the peripheral areas. With regard to productive assets, the thesis found evidence suggesting high levels of inequality on three levels. First, high differences were observed in mean and median values of assets for all groups, but in particular smallholders cultivating less than 2 ha in areas with no infrastructure. Second, great disparities were found between the mean value of assets across group sizes, regardless of geographic locations. For instance, the mean value of assets for the less-than-2 ha segment was found to be K4119, whereas for the 10–20 ha segment, it was K42008 in peripheral areas. Finally, looking across all groups on a spatial level, great disparities exist between areas with no infrastructure and areas with M- and T-road infrastructure.

Additionally, it was found that the below-2 ha segment was more sensitive to the level of infrastructure, with higher levels of inequality between geographic areas.

With regard to access to capital, education and fertiliser, spatial location and distance reported affected both amount and price. As to access to credit, the most frequent borrowers were small-scale farmers, whose credit most often is in the form of outgrower schemes. Further, when looking at the where most of the loans took place, it becomes apparent that the majority is situated along the T-road going north and northeast, and along the M-road, going from the centre to the west. Educational level and price of fertiliser were found to correlate negatively with the household's reported distance in time travelled. However, the amount bought per household was found to increase as distance increased. This is likely because of economies of scale and because the capital level of those buying fertiliser in the periphery is stronger than those who do not—i.e. those in the periphery buying fertiliser probably have more land to cultivate and higher levels of capital, meaning that transport price per unit of fertiliser becomes lower and therefore more viable. The same may be true for FISP-supported fertiliser, as amounts were also found to correlate with distance. The main reason for this belief is due to the report of a higher number of medium-scale farmers using government-supported inputs.

Establishing new links for better market integration, vis a vis better physical infrastructure, would assist smallholders in gaining better access to credit, knowledge and education, more affordable assets and inputs, as well as lower transport costs in general. Greater physical infrastructure could also increase the level of farmers in the area, both large- and small-scale, which could have positive dynamics in relation to knowledge sharing and the combined gravity of greater demand for the maintenance of existing infrastructure, education, credit and fertiliser inputs, which would mean higher productivity among smallholders. However, if not managed correctly, the benefits of greater agglomeration can be outweighed by urbanite and foreign landgrab leading to higher reports of land scarcity, as currently seen in the central areas. Nonetheless, presented with more efficient infrastructure that could provide more cost-effective access to markets in combination with a favourable policy regime that promotes small-scale productivity and access to good fertile land, there should be no reason why small-scale farmers cannot commercialise and increase their incomes.

7.1 Future Research & Policy

Generally, there has seemed to be a problem with SSA's institutions, quite often reported as inefficient and with high levels of retainer labour that add little or no incremental value. In the case of Zambia, several media reports have also indicated that aspects of the public institutions are flawed and inefficient. This is often expressed as a lack of long-term commitment to projects, and often carrying out overly complicated and expensive projects that afterward cannot be maintained by local authorities. The implementation of development policies, long-term commitment to road maintenance and reducing corruption among several public institutions would be relevant to providing insights into the rate at which broad-based development can happen. Extending research into this area would mean a greater understanding of policy and institutional analysis that have largely been outside the scope of this thesis.

Further, the exact relationship between infrastructure markets and commercialisation has yet to be uncovered. There are many other factors that affect smallholder productivity and the market in which smallholders operate.

Apart from the policy framework, such factors could include level of capital in the area, population density, number of large-scale farms and agro-industry links. In turn, the nature of these factors is shaped by the historical trajectories. Uncovering the historical trajectory of the Line of Rail in relation to change in factor endowments to proximate areas could assist in better understanding how new large-scale infrastructure projects, not only pertaining to transport infrastructure, might affect the rural dwellers in affected areas.

Rural-development policies seem mainly to have taken three different approaches: greater diversity of products; better public service in the form of storage facilities, educational training and ICT systems; and greater promotion of small-scale farming. The latest policies focus on the intensification of producing high-value crops for export markets, along with an increased focus on greater mechanisation, in order to achieve higher productivity and to continuously enhance access to agricultural training, credit and input supports.

The intention to improve and promote small-scale agriculture is to be achieved through further developing farmers' organisations and rural infrastructure. While continuing to provide affordable credit and input support programmes, there is no stated intention of attempting to integrate the more peripheral farmers who use these services less due to poor market integration. However, the hopeful intention of developing farmers' organisations may harness the combined power of its members to solve local problems, such as inadequate services, by mobilising human and financial resources that can push for greater and more sustainable development. New opportunities for smallholders, can grant smallholders the opportunity to lower input costs and raise productivity. They can establish agro-industry linkages and engage more agricultural producers in commercial farming. However, it is far from thought to action. What often seems neglected, is how these projects are supposed to be implemented and financed.

It is therefore the hope of the author that despite, weak results, this thesis can serve to refuel a debate on development projects and regional disparities amongst developing nations.

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Appendix A: Observed Infrastructure

District	Observed Infrastructure		
Chibombo	2	Nakonde	2
Kabwe	2	Chilubi	1
Kapiri-Mposhi	2	Kaputa	1
Mkushi	2	Kasama	3
Mumbwa	3	Luwingu	3
Serenje	2	Mbala	3
Chililabombwe	2	Mporokoso	1
Chingola	2	Mpulungu	3
Kalulushi	2	Mungwi	1
Kitwe	2	Chavuma	1
Luanshya	2	Ikelenge	2
Lufwanyama	2	Kabompo	3
Masaiti	2	Kasempa	1
Mpongwe	2	Mufumbwe	1
Mufulira	1	Mwinilunga	2
Ndola	2	Solwezi	2
Chadiza	1	Zambezi	3
Chipata	2	Choma	2
Katete	2	Gwembe	1
Lundazi	1	Itezhi-tezhi	3
Mambwe	1	Kalomo	2
Nyimba	2	Kazungula	2
Petauke	2	Livingstone	2
Chienge	1	Mazabuka	2
Kawambwa	3	Monze	2
Mansa	3	Namwala	3
Milenge	1	Siavonga	2
Mwense	3	Sinazongwe	1
Nchelenge	1	Kalabo	1
Samfya	1	Kaoma	3
Chongwe	2	Lukulu	1
Kafue	2	Mongu	3
Luangwa	1	Senanga	3
Lusaka	2	Sesheke	3
Chama	3	Shang'ombo	1
Chinsali	2		
Isoka	2		
Mafinga	3		
Mpika	2		

1 = No major infra
2 = Main-road
3 = Trunk-road

Appendix B: Results from model estimation

Results from OLS regression and estimation of models

Linear regression

fr02	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fr03	0.014	0.001	10.56	0.000	0.011	0.016	***
1b.fr05	0.000	.	.	.	.	.	
2.fr05	-1.547	0.757	-2.04	0.041	-3.031	-0.063	**
1b.fertch	0.000	.	.	.	.	.	
2.fertch	7.078	3.604	1.96	0.050	0.014	14.142	*
3.fertch	14.661	1.348	10.87	0.000	12.018	17.304	***
hect_cult	-1.837	0.319	-5.76	0.000	-2.462	-1.212	***
1b.fertch#co.hect_~t	0.000	.	.	.	.	.	
2.fertch#c.hect_cult	-1.012	0.706	-1.43	0.152	-2.396	0.373	
3.fertch#c.hect_cult	2.454	0.260	9.43	0.000	1.944	2.965	***
1b.fertch#co.eduhead	0.000	.	.	.	.	.	
2.fertch#c.eduhead	-0.440	0.465	-0.95	0.344	-1.351	0.471	
3.fertch#c.eduhead	0.464	0.152	3.05	0.002	0.165	0.762	***
eduhead	-0.488	0.124	-3.94	0.000	-0.731	-0.245	***

o.hect_cult	0.000	.	.	.	.	.	
c.eduhead#c.hect_c~t	0.236	0.037	6.45	0.000	0.164	0.307	***
Constant	7.313	1.053	6.95	0.000	5.250	9.376	***

Mean dependent var	14.429	SD dependent var	36.077
R-squared	0.157	Number of obs	14509.000
F-test	245.182	Prob > F	0.000
Akaike crit. (AIC)	142770.486	Bayesian crit. (BIC)	142861.476

*** p<0.01, ** p<0.05, * p<0.1

Contrasts of marginal linear predictions
Margins : asbalanced

	df	F	P>F
fertch#c.hect_cult	2	49.720	0.000
fertch	2	59.170	0.000
fertch#c.eduhead	2	5.530	0.004
Denominator	14497		

	Effect sizes for linear models Eta-Squared	df	[95%Conf.	Interval]
Model	0.157	11	0.146	0.167
Ferrtiliser q.	0.008	1	0.005	0.011
Fertliser availability	0.000	1	0	0.001
Fertiliser Source	0.008	2	0.005	0.011
Area cultivated (ha)	0.001	1	0.000	0.002
Fertiliser source*area cult	0.007	2	0.004	0.010
Fertiliser source*education	0.001	2	0.000	0.002
education	0.001	1	0.000	0.002
Education*area cultivated	0.003	1	0.001	0.005