Motivation, Risks and Class Effects of Land Policy in a Colony: Lessons from Southern Rhodesia

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Abstract

Post-colonial states have inherited a skewed land distribution pattern. The aspiration to redistribute land amongst indigenous peoples has always been alive in many post-independent states. However, land redistribution progress in many parts of the world has been hampered mainly by uncertainty over the political and economic risks involved; yet land reform is not entirely a new concept. The colonial forebearers of the present governments in these post-independent states attempted different forms of land policy. This paper uses the example of Southern Rhodesia (now Zimbabwe) to analyse the incentives or motives for land reform in a colony. Using the 1962 election, the study discusses the political risks of land reform, which may explain why present-day governments tend to tread carefully where land reform is concerned. Additionally, the paper examines the class effects of land reform in Southern Rhodesia. Specifically, it descriptively tests the assertion that the Native Purchase Area (NPA) farmers represented a well to do African middle class. Finally, the study tests the effect of access to infrastructure on crop production, using Landsat image data from the Multi Spectral Scanner (MSS) that are classified using machine learning techniques.

Introduction

Post-colonial states in Africa, Asia and Latin America have inherited a legacy of racially skewed land distribution. In these countries, the expectation that colonial land imbalances should be redressed so that the indigenous peoples can be economically empowered has always been alive. This is especially so because land grievances were the major factor motivating dissent against imperialism and the brutal struggle for liberation that eventually delivered majority rule in most of these countries. However, progress to land reform post-independence has been very slow, with the exception of a few notable examples such as Bolivia, Cuba, Mexico and Zimbabwe; with the latter being the most recent 21st Century case, and the most successful[1] on the African continent. The main reason why land reform has been slow is that countries are either unsure about or unprepared for its economic and political implications. The present day ruling class of post-colonial states have much to learn from their colonial predecessors. Zimbabwe (formerly Southern Rhodesia) has an interesting history, and land reform is definitely not something new as the colonisers of the country used it as their most effective economic and political tool. This paper traces the history of colonization and the land in Zimbabwe in an attempt to answer several research questions.

Theory identifies three main motivations for Land Reform. These are political, economic and egalitarian. The first research question is therefore whether these motivations apply in a colonial state. The paper thus describe and discuss the incentives that influenced institutional segregation of the land in Southern Rhodesia, which is regarded as a form of land reform in this study. Secondly, this paper attempts to show that although land reform has been touted as a survival strategy for the ruling class, the history of Southern Rhodesia shows that this is not guaranteed – there is uncertainty. As already mentioned, there is much uncertainty with regards to the effects of land reform on the economy. The third objective of the paper is to investigate whether access to land is enough, because in Southern Rhodesia the physical lack of access to good quality land by Africans might only have been a part of the intricate web of institutions hampering the economic emancipation of the Africans. Related to that that, the fourth aspect of this paper investigates the existence of a rural African middleclass in the Native Purchase Areas (NPAs) and how the spatio-temporal effects of infrastructure and a partial lifting of segregationist policies from the late 60s affected crop production. The paper uses a machine

[1] Successful in terms of actually acquiring the land and re-distributing it amongst the previously disadvantaged African population. (Cite XXX)

learning methods for land classification, and then computes the amount of land under crop production for the NPAs, European Areas (EAs) and Tribal Trust Areas (TTAs) from 1965 using Landsat images.

Birth of a Colony

Rhodesia – The Beginning

Before 1890, the territory between the Zambezi and the Limpopo rivers and bordered by Portuguese East Africa to the East and Bechuanaland to the West was inhabited by two tribal groups - the Shona in the north and the Ndebele in the south. After the Otto van Bismark hosted Scramble and Partition for Africa Conference at Berlin in (), XXXX reveals that Britain was financially hamstrung to seek more territory on the continent (XXX). However, it found in Cecil Rhodes (the Premier of the Cape Colony) a man with the ambition, financial and military resources to further British interests by taking the territory north of the Limpopo (XXXX). On the part of Rhodes and his company British South African Company (BSAC), it could have been a question of commercial interest more than it was national duty. That the desire to find and exploit vast gold deposits is the ultimate motivation for the BSAC to cross the Limpopo into Zimbabwe in 1890 is well documented, see (Andersson & Green, 2016; Green, 2016; Robin Palmer, 1971). However, the top hierarchy in the company had by that time realised that gold deposits that they would find were not as high as earlier thought (Green, 2016), thus the occupation of Zimbabwe could well have been a gesture of national duty by Rhodes. Good (1976) and Robin Palmer (1971) suggest that imperial Britain viewed the conquest of areas adjacent to its present interests as a way of strategic defence, thus the settlement of Rhodesia in 1890 was in order to protect the wealth of British South Africa and India from nearby Portuguese and German empires; and the threat and influence of the Afrikaners.

To set the colonization plan into motion, an invading force of 200 pioneers and 500 policemen (The Pioneer Colum) trekked from South Africa, via Bechunaland (present day Botswana) into Zimbabwe, conquering the primitively armed local resistance (Rifkind, 1969). The ‘Settlers’ quickly subdued both the Shona and the Ndebele, raising The Union Jack at Fort Salisbury (present day Harare) on 12 September 1890 (Rifkind, 1969; Summers, 1994). As Arrighi (1967) observes, upon the birth of Rhodesia, there had been overestimation of the gold resources of the territory. Such overoptimistic view of the gold resources would persist for one

and half decades; with the BSAC in the meantime investing in other infrastructure such as railways and the land itself to recover on costs (Arrighi, 1967). To demonstrate how the gold discovered fell short of expectations; Arrighi (1967), mentions that in 1910 the 11 top mines in Johannesburg realised a profit of £7 million while their top 10 counterparts in Rhodesia realised less than £1 million. Arrighi (1967), explains the disparity by stating that the mines in Rhodesia were spread across the entire country and the ore was of a lesser quality. It was therefore imperative to encourage the development of a white agriculture bourgeoisie echelon of society that would increase the value of land, railway, mines and other assets as way of recovering the initial heavy financial outlays the BSAC had made (Arrighi, 1967). As hopes of discovering gold reserves the equivalent of those in South Africa waned, the Pioneers shifted their attention to the land (Andersson & Green, 2016; Duggan, 1980; Frankema, Green, & Hillbom, 2016; Moyana, 1975; Pollak, 1975).

Changes in Land Distribution before 1930

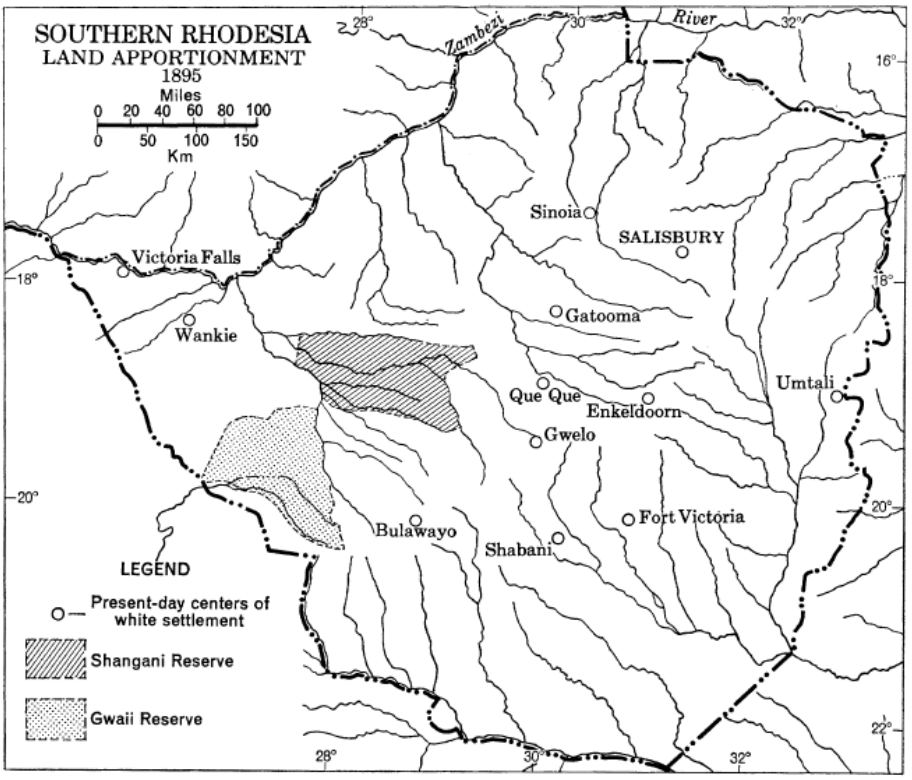
After raising the Union Jack at Fort Salisbury in 1890 in Mashonaland, the BSAC was granted the Royal Charter to administer the colony until 1915, although this would be extended by another ten years (Rifkind, 1969). Partly because the Shona were disunited clans scattered across the entire north-eastern region of Mashonaland, they did not offer much resistance to the invading Pioneer Column. In fact, the arrival of the Europeans ended the siege of the more united Ndebele over the Shona. All this time, the Pioneer Column had avoided direct confrontation with the powerful Ndebele army, but with time they failed to discover abundant gold reserved in Mashonaland as they had thought, and then started eyeing the agricultural land of the Ndebele (Moyana, 1975).

All land became the property of the Crown, and the Company acquired large tracts of land for sale to European immigrants (Floyd, 1962; Pollak, 1975). Pollak (1975) mentions that the company acquired the land by "treaty, occupation and conquest". For example, in describing the conquest over the Ndebele, Floyd (1972) in Moyana (1975) says that On 14 August 1893, Star Jameson, a close confidante of Cecil Rhodes signed a secret treaty for the invasion of Lobengula's Kingdom, with one of the clauses promising 6000 acres as farmland in Matebeleland to each member of the invading force.

After the war, so called the "war of dispossession", the British Government gave Order-in-Council that required the appointment of the Land Commission, that would deal with all land

disputed in Matebeleland (Floyd, 1962; Moyana, 1975; Stocking, 1978). This Commission recommended the creation of Gwai and Shangani (see Figure 1) for resettlement of the defeated Ndebele (Floyd, 1962; Moyana, 1975; Robin Palmer, 1971). Gwai and Shangani, the first two reserves were only a quarter of the previous Ndebele kingdom, and the soil was barren and dry as observed by the British Deputy Commissioner in 1897 (Moyana, 1975).

Figure 1 The First Reserves

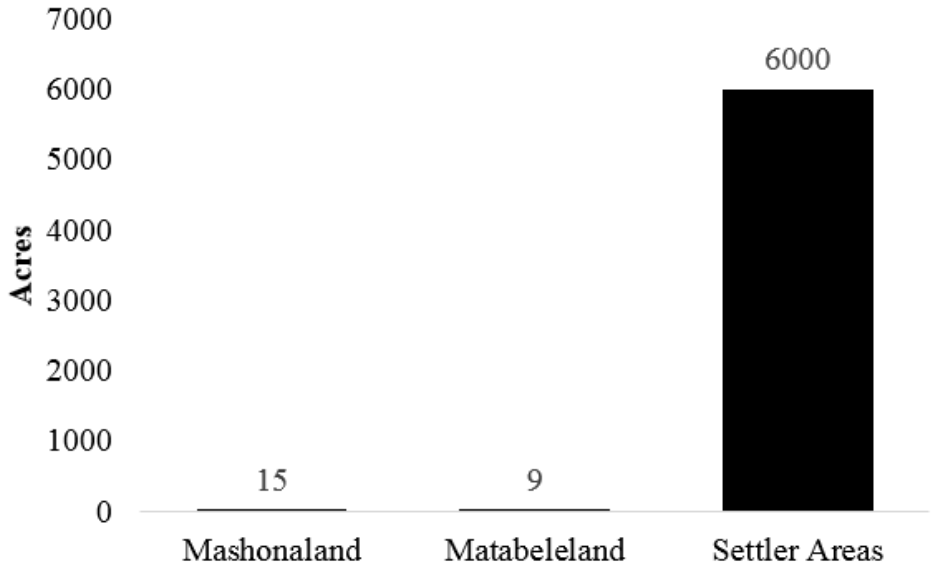


Source: Adapted from Floyd (1962) with minor modifications

Floyd (1962) observes that overcrowding in the Gwai and Shangani may have led to the Ndebele Uprising of 1896, while the Shona Uprising in that very year might also have been fuelled by land grievances in Mashonaland. To force the BSAC to address the overcrowding in these first two reserves, Britain's Order-in-Council of 1902 instructed that sufficient land be given to Africans to Africans (Floyd, 1962). Native Commissioners were thus empowered to parcel out more land to Africans in the final reform to the native reserves (Moyana, 1975). The years that succeeded resulted in designation of the most in the Highveld to Europeans, as Africans were moved into Native Reserves (Floyd, 1962; Moyana, 1975). Land allocation to Africans in Matabeleland was in accordance to the Cape Colony's Glen Grey Act where each

African family received 9 acres of land, yet in Mashonaland the size of the family plot was set at 15 acres (Floyd, 1962; Moyana, 1975). Meanwhile creation of the native purchase areas expanded between 1902 and 1920. Figure 2 shows the disparity in land allocation amongst Africans in Mashonaland, Africans in Matabeleland and Europeans. Clearly, land ownership by the Settlers dwarfs the small holdings of the Africans.

Figure 2 The Disparity in Land Allocation



S**ource:** Own illustration using figures in Moyana (1975)

By 1910 Europeans had confiscated around a quarter of the land (Herbst, 1991). This is confirmed by the figures in Table 1. The Native Reserves Commission, set up in 1914 noted with concern the rapid multiplication of the African population and recommended that going forward it was impractical for every African born to have access to land or raise livestock (Floyd, 1962; Machingaidze, 1991). Before World War I, there were 108 reserves created in Southern Rhodesian, but during the war these would be regrouped such that in by 1920 they were 83 (Floyd, 1962; Machingaidze, 1991). Floyd (1962) reveals that of the 21594957 acres set aside for the native population in 1920, 3 million were totally unsuitable for habitation.

Table 1 Land Holdings as at 1911

Category	Acres	Percentage of country
European Area	19032320	20.7
Native Reserves	21390080	23.2
Unassigned Area	51628800	56.1
Total	92051200	100

Source: Southern Rhodesia, Report of the Native Affairs Committee, in Moyana (1975)

Before 1930, Africans were able to purchase land in the colony. Jennings and Huggins (1935) and Pollak (1975) cite an Order-in-Council of 1898 that ruled that a Native could purchase, hold and sell land under the same conditions as those of the non-Native as espoused by Rhodes the founder of the colony in 1890. Although Africans could purchase land, they seldom did so as very few among them could afford it at the time, and it is only the concept of communal land ownership that they understood (Floyd, 1962; Jennings & Huggins, 1935). By 1921, European settlers had bought 31 million acres of land versus the 40 000 – 47 000 bought by African farmers (Arrighi, 1967; Moyana, 1975; Pollak, 1975).

The Incentives Structure influencing the Institutionalized segregation of the Land

Land segregation was a key element of Rhodesian politics (Moyana, 1975). The Land Apportionment Act (1930) is one of several pieces of legislation that the colonial government had enacted to protect their interests (Ncube, 2000; Ranga, 2004). Ranga (2004), comments that such repressive legislation basically ensured that by 1963 the native African population of more than 2.5 million squeezed themselves within 50000 square miles of land while the just over fifth of a million settlers enjoyed the other 75000 miles.

Literature identifies three motives for land reform, namely political, economic and egalitarian (Zarin & Bujang, 1994). Was altering of the existing land tenure upon colonization in Southern Rhodesia a pursuit of one, some or all of these motivations or it was an unintended consequence? Arrighi (1967) appears to argue that the usurping of the land was not the intention of the invading Settlers, but an unintended consequence of colonization. Yet, members of the Pioneer Column were promised parcels of land XXXX. Good (1976), in an explanation of the use of the force (guns) during colonialization, says that superior force, a by-

product of Europe's industrial advancement was key so that the imperialists could have absolute control over the land and "probably the cheapest labour in the entire world". Thus, the taking of the land upon colonization might have been inspired by political and economic motives. This section describes the incentive structure in Southern Rhodesia that culminated in the Land Apportionment Act of 1930, further on.

Eliminating Competition from African Peasantry

African post-independent states today are not sure whether they can entrust commercial farming into the hands of the local population. They are not sure whether local farmers have the ability to maintain the production levels of the farmers of white farmers. However, for Southern Rhodesia, history shows that the Africans were a formidable force in as far as agriculture is concerned. Thus, one of the factors that influenced the institutionalised land segregation was to destroy African agriculture.

Upon colonization, the Africans were agriculturalists, and their openness to trade reflects that they understood to some extent the market economy (Phimister, 1974). In 1890 some Shona were selling farm produce to the Pioneer Column and they appeared to be enthusiastic about business and trade (Phimister, 1974). The Ndebele too, seemed awake to the market opportunities that colonization had brought and Phimister (1974) names a trader called Dawson who wanted to arrange the sale of cattle and sheep to the Europeans in Mashonaland on behalf of Lobengula, the Ndebele king in 1891. Thus, contrary to the narrative of being unproductive as publicised by the Southern Rhodesia state, the Africans were agriculturalists and rational economic agents. Peasant agriculture was very important to the existence of mines such that a partial crop failure in 1895 put pressure on prices to rise, causing temporary shutdown of some mines (Phimister, 1974). Phimister (1974) gives the example of Wedza District, that usually provided large quantities of grain to mining areas in Matabeleland.

Andersson and Green (2016) cite Phimister (1988) who observe that the native commissioner of Chilimanzi (now Chirumanzi) wrote that by 1904 the African produced 90% of the country's crop production available for market while at the same time two fifths of the state revenues came from hut taxes. Andersson and Green (2016) show that in the early years of Southern Rhodesia, some portions of African society were doing fairly well, purchasing imported consumables and even buying land from poorer white farming households. In the period

preceding the World War I, Phimister (1974) posits that the Native peasantry constituted the bulk of the food supply for the export producing regions. The expansion of the settler mines at the beginning of the colony (at least before 1908) without a corresponding capitalistic farming community had helped bolster the African peasants from a market point of view (Phimister, 1974). Robin Palmer (1971), Phimister (1974) and Duggan (1980) notes that at the beginning of the 20th Century, the Africans were formidable agriculturalists, but the Settlers would after 1908 embark on the destruction of African agriculture. Duggan (1980), states that by 1915, Southern Rhodesia no longer needed to depend on peasant food production.

By the 1920s the European farmers faced the challenge of overproduction thus to reduce competition from African tenants on their land they introduced higher grazing and dipping fees as well as land rent so that the latter would move to the designated reserves (Andersson & Green, 2016). The depriving Africans their only source of livelihood (agricultural earnings) is what is referred to by Arrighi (1967) and Green (2016) as the proletarianization of African peasants. Europeans were against the prospect of having Africans continue to fill their areas and competition so they advocated for complete separation of the land (Moyana, 1975). In destroying African agriculture, the Settlers wanted to develop a proletariat African class as a way of guaranteeing labour supply and reducing completion on the farm produce market.

The need to develop a Proletariat Class and Guarantee Labour Supply

Settlers needed a consistent source of labour to work their fields and mines. Land segregation in Southern Rhodesia targeted the elimination of economic competition from the Natives and their relegation to a lower strata which would compel them to perpetually feed the labour demands of commercial agriculture, manufacturing and mining. Phimister (1974) observes that the rise in mine wages between 1899 and 1902 was not a result of more gold profitability but due to low labour supply pushing wages up. To guarantee that the wage bill remained low in both farming and mining, institutionalised segregation was key. Although the mining houses would later be able to reduce costs by outsourcing labour from other African countries, they much more effectively managed to achieve this labour cost reduction through progressively sabotaging the development of the peasant agricultural sector (Phimister, 1974). The intention of the Settlers was not only to hamstring peasant agriculture as a source of African livelihood, but also went as far as destroying the trade in commodities that had boosted in the early days of the colony. As observed by Phimister (1974), shortly after 1890, mines were an important

market for peasant produce, but with a set of legislation and declining mining wages, this market eventually declined. Arrighi (1967), Clarke (1975) and Duggan (1980) also concur that the Act aimed to expand the supply of labour and create non-competing racial groups in the economy.

However, one is inclined to think that even without segregation, the Settlers would still have managed to develop a proletariat class. As the Natives became more in touch with the money economy, and as they became attracted to European goods such as education and clothing, the labour supply market expanded even more (Arrighi, 1967). Thus, the need to work would still establish itself as not everyone could be a trader and eventually the stock of cattle that Natives usually converted to earn some cash would at some stage deplete.

The Speculative Motive

The segregationist land reform in Southern Rhodesia may have been purely because the Settlers believed so much in the appreciating value of the land over time, and thus were inclined to hold as much land as possible. Machingaidze (1991) refers to a 1949 government report that indicated that a huge portion of land in the European farming areas were not at all being utilised, introducing the possibility that much of the land was being held for speculative purposes. In the 1949 report the government revealed that government it could not trace or verify the owners of a significant number of farms, which dovetails into the observation that some of the land was marked for foreign acquaintances. During the Todd administration, The Select Committee in 1956 found that in all the European Areas, only 3-4% of the land was under crop production.

Vested Interests, Racial Prejudice

Why Southern Rhodesia finally decided on an apartheid distribution of the land can also be explained by the vested interests of the Morris Carter Commission 1925 (also known as The Land Commission) and racial prejudice. Firstly, the composition of the Land Commission set up in 1925 to bring closure on the issue of the land was in actual effect made of up former employees of the BSAC who obviously had vested, imperial interests of furthering European dominion (Andersson & Green, 2016). Secondly, literature consistently shows that there existed racial prejudice between the whites and blacks. For Southern Rhodesia, the seeds of racial prejudice against the Native population by the Europeans had probably been sowed after

the Ndebele and Shona uprisings in 1894. Kay (1980), asserts that the BSAC adopted a segregationist policy due to the "impassable" rift separating the European and African races. The word "impassable" shows the extent of prejudice that existed between the European and African races.

The Land Apportionment Act

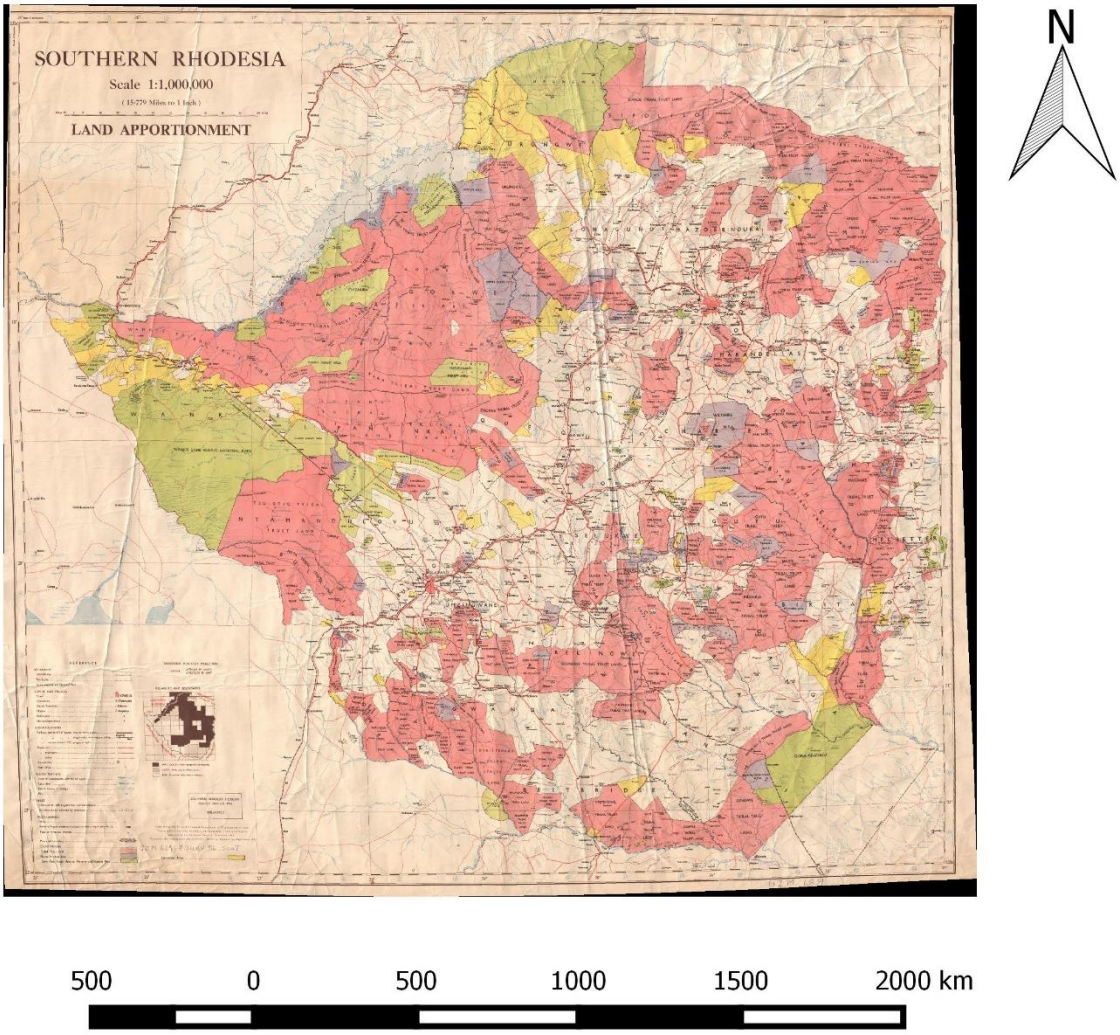
The politics of land in Rhodesia was a restive subject. Machingaidze (1991) argues that to deter competition, it was never the objective of the colonial administration to promote commercial African agriculture - yet the Native population was quite aggrieved by the continued disenfranchisement from their land (Duggan, 1980; Herbst, 1991; Moyana, 1975; Pollak, 1975). Jennings and Huggins (1935) state that the Act was formalised segregation between races in Southern Rhodesia. Duggan (1980), Machingaidze (1991) and Moyana (1975) note that there had several legislative measures meant to keep the African out of agricultural competition, but The Land Apportionment Act was the most prominent. To bring the issue of the land to finality, and to consolidate the unfair advantage that Europeans held over the Native population, the Land Commission, also known as the Morris Carter Commission was formed in 1925. Only 2 out of 111 European famers considered by the commission for an opinion were against complete institutional segregation of land against Africans (Moyana, 1975). Such a result is thus consistent with the observation by Youé (2002) that racial domination was the major motivating force behind land apportionment.

The commission recommended that racial tension in the colony was a product of the contact between the European and African races, thus complete separation was warranted (Floyd, 1962; Jennings & Huggins, 1935; Pollak, 1975). The recommendations of The Morris Carter Commission were thus, promulgated as The Land Apportionment Act in 1930 (Floyd, 1962; Pollak, 1975). Machingaidze (1991) discloses that Settlers regarded the Act as their Magna Carta. Pollak (1975) says that some referred to it as the 'White man's bible' as they viewed it as the balustrade supporting the existence of their society.

The colonial government frowned upon the idea of complete segregation and a compromise was arrived in setting up the Native Purchase Areas (NPAs) where Africans could buy land (Andersson & Green, 2016). The colonial administration believed that very few Africans would have the financial resources to buy land (Andersson & Green, 2016). The Africans' rights to the land were thus suspended, except in the 81 NPAs (Floyd, 1962; Jennings & Huggins, 1935).

Following promulgation of the Act, Africans were forcibly moved Native Reserves, where the tribal communal system of land tenure existed (Floyd, 1962).

Figure 3: The Land Apportionment Act Land Distribution



Source: Federal Department of Trigonometrical and Topographical Surveys, Rhodesia and Nyasaland (1963). Available online at: http://www.digitalcollections.lib.uct.ac.za/special-collections-maps

In the Land Apportionment Act, the Native is defined as any person who was an aborigine of the African tribes, or any person who African aboriginal blood ran through his her veins; and lived an 'African' way of life – thus coloureds and Asians had the same land rights as the

Europeans (Jennings & Huggins, 1935). The Land Apportionment Act of 1930 formally delineated land on a racial basis, as one race could not purchase land in an area designated for the other. Around the time of the passing of the Act, around half of the entire land in the country had been designated for the whites, while only 30% has been set aside for the Africans (Herbst, 1991). Figure 3 presents the skewed land distribution that was formalised by The Land Apportionment Act.

Europeans viewed the skewed distribution of land as fair (Good, 1976). As Christopher (1971) explains, Europeans viewed the distribution as fair because there was low productivity in the African reserves. Nelson (1982) gives a more interesting viewing, indicating that Europeans actually viewed the Land Apportionment Act as a primary source of 'inequality' in the sense that they wanted 50% of the land allocated to the whites and 50% to the Africans regardless of their disproportionate numbers.

The Prosperity of Southern Rhodesia and the African Middle Class in the NPAs

For a country as prosperous as Southern Rhodesia, the argument that some of that prosperity spilled over to some sections of the African community is what Andersson and Green (2016) assert. Some brief background on the factors influencing this prosperity is thus presented. The colonisers of Rhodesia foresaw that the future of the colony would be based on the country's vast agriculture and pastureland. In Africa, Southern Rhodesia was the winner of the race from both agriculture and economic prosperity point of view. In the 1950s, the country was the main producer of tobacco in Africa (Haviland, 1953); and it was the most prosperous state in British Africa (Andersson & Green, 2016). Good (1976) argues that Rhodesia had enormous advantages because of its relatively rich endowment of natural resources such as iron, steel, asbestos and various crops in comparison to Kenya for example. Figure 4 shows that the strengthening of agro-industrial linkages, and a decline in the contribution of mining to the economy of the colony.

Figure 4 The Contribution of Mining and Manufacturing to GDP

A. Declining Importance of Mining **B. Increasing Importance of Manufacturing**

*Source***:** own illustration-using data from A. Arrighi (1967), B. Good (1976) and Machingaidze (1991)

World War II had a major boost to the economy of Rhodesia (Arrighi, 1967). As asserted by Arrighi (1967), war-induced scarcity of imports encouraged domestic industry growth, war-induced export demand sought Rhodesian agricultural and mineral output; and the "air training scheme" in partnership with Her Majesty's government allowed Rhodesia to supply Allied air bases. Given the importance of African agriculture in the early days of the colony, this paper investigates whether the agriculture boom as a result of WWII did not positively influence production in the NPAs as well.

Introduction - The African middle class

The question 'Can the farmers in the NPAs be viewed as a bourgeoisie, middle class or just a proletariat class?' forms the crux of this paper. Although colonial policies were biased towards maintaining the prospects of settlers, which did not entirely hamstring development for all the African population because the ruling elites do not completely hold the dynamics of social change (Andersson & Green, 2016). Andersson and Green (2016)indicate that unintended results occupy a central place in the analyses of the development path that was taken by former colonial governments in Africa. Although the motivation for the policies that were implemented by settler governments were indeed meant to benefit Europeans, some sections of African society benefitted through spill over effects (Andersson & Green, 2016).

This study thus investigates the middle class in the Southern Rhodesia. It asks whether the relative economic stability of the colony is something that can be cherished, at least by the middle class – when compared to the modern economic situation in Zimbabwe. In explaining why policies that favour European elitism unintentionally created opportunities for some of the indigenous Africans, Andersson and Green (2016) offer the emergence of the NPAs as an illustration. This paper clinically examines the performance of the farmers in the NPAs. As in other studies that have traced the development of the Rhodesian state, this paper shades more light on this process, but more importantly introduces an unconventional dataset to test how well the NPAs (part of the African middle class) were doing. The colonial administration viewed the NPAs as having negligible contribution to the country's agricultural production (Andersson & Green, 2016), yet literature shows that farmers in the NPAs areas performed above average and their surplus produce was important for the domestic market. This paper investigates that using machine learning techniques to classify data from the Landsat MSS sensor.

The Effects of the Land Apportionment Act on Productivity

Altering tribal land tenure rules could not be done without irreversible damage to the people (Hughes, 1971). The effects of the Land apportionment Act were different but in some respects similar between the Native Reserves (NRs) and the NPAs. In the NRs, the Act cast in stone permanent land for grazing and permanent land for farming for the Africans, thus they had to switch from shifting to continuous agriculture, resulting in soil erosion and reducing the fertility of their land (Arrighi, 1967; Duggan, 1980; Machingaidze, 1991). Moyana (1975) asserts that the skewed distribution of land as a result of the Act subjected Africans to serfdom and limited the extent to which they could actively participate in the economic development of the country. It created the feudal system of land tenure where the European farmer had a native and his family settle on their farm in exchange for labour supply (Arrighi, 1967; Moyana, 1975; Youé, 2002). Although the feudal system was absent in the NPAs, the quality of the land in the NPAs were more or less similar to the NRs.

Almost three quarters of the land allocated for Africans was drought prone, dry and more suitable for only extensive livestock and crop production, in contrast to the European areas where good rainfall allowed intensive crop and animal production (Floyd, 1962; Herbst, 1991; Robin Palmer, 1990; Pollak, 1975). Moyana (1975) observes that African areas were carved out in the dry low veld whose soils did not have much potential; while Floyd (1962) laments

broken terrain, dryness, lack of water and tsetse fly infestation in these areas. This is despite the fact that the majority of Africans[2] relied directly on agriculture, in stark contrast to only 30% of Europeans whose livelihoods were linked to the disproportionate land that they held. Machingaidze (1991) further notes that settlers held almost 100% of the areas that were suitable for dairy farming while at the same time Clarke (1975) notes that 77% and 64% of the land that could be classified as suitable for intensive and semi-intensive farming respectively was in European Areas.

Europeans justified the allocation of red, clay and richer dolorite and greenstone soils to themselves and the allocation of sandy, granite rock and limestone areas to Africans because the latter were only equipped with simple hoes and could thus not farm the heavy red and clay soils (Floyd, 1962). Robin Palmer (1971) sheds more light on that argument, saying that the Shona had historically preferred to work the sandy, loose soils as they were easier; suited their staple *rapoko;* and were situated in areas with kopje granites that they used as fortresses during the Ndebele raids.

The NPAs were no exception (Machingaidze, 1991). As noted by Clarke (1975), Floyd (1962), Machingaidze (1991), Robin Palmer (1971), Stocking (1978), NPAs were located adjacent to the Native Reserves, and like the Native Reserves were far away from transport and communication infrastructure, lacked water, and the soils largely infertile (Pollak, 1975). For example, Clarke (1975) mentions that in 1970, more than one third of European Areas were within 10 miles of a station or siding, while nearly a quarter were within 20 miles, with only 6% located at a distance of more than 50 miles from a rail line. Even with respect to main urban centres (markets) EAs were much nearer than the Tribal Trust Reserves and Native Purchase Areas (Clarke, 1975).

Against this background, the viability of an African middle class in the NPAs might be doubtful. The NPAs did not only lack good soils, access to infrastructure and markets; but they did not have the effective organization as of the Rhodesian National Farmers Union (RNFU) – which had been established in 1949[3] by the European farmers (Herbst, 1991). The RNFU had important influence, if not coercion on the colonial government since the latter relied on the former's increased crop production to meet the requirements of World War II (Herbst, 1991). Haviland (1953) offers that after WWII, African evictions from European designated areas

[2] Clarke (1975) puts 60 – 70% as the figure for Africans living and depending on rural land
[3] Herbst (1991)

created land that was allocated to ex-service men. The RNFU should have been the main force influencing government at the time. The RNFU was able to pressure the administration to pass the Farmers Licensing Act, which compelled farmers to purchase a farming licence from the union, effectively shutting out African farmers from state sponsored research and other benefits of union lobbying (Herbst, 1991). Another area were farmers in the NPAs were excluded is access to finance (Machingaidze, 1991). For example, the Land and Agriculture Bank that had been formed in 1924 to support agriculture served "persons of white descent only" (Machingaidze, 1991). This then introduces another hypothesis that; It is more than just land. The better productivity of the European farms cannot be entirely explained by the fact that they held more, high fertile land, but because they also had access to government agricultural research, markets and finance.

To support the view that it is more than just land, Moyana (1975) posits that European settlers could not or were not fully utilising the vast tracts of land that they had acquired, reducing the GDP potential. Africans had unfertile lands at their disposal, thus their agricultural output could not meaningfully contribute to GDP, coupled with marketing restrictions on African produce (Moyana, 1975; Pollak, 1975). Pollak (1975) cites lack of support from government and title deeds, unavailability of labour, discriminatory marketing that shut Africans out and lack of seriousness on the part of the government. Phimister (1974) notes that Africans were unable to reinvest in their agriculture because they were getting very little returns; they could not undersell the European farmers because many a times the latter sold produce on behalf of the former and even if the African supplied local traders, it is the traders who always had the lion's share.

Arrighi (1967) indicates that the African middle class and rural bourgeoisie classes were not significant from a numbers and economic contribution point of view; yet Andersson and Green (2016) sees the African middle class as significant. Good (1976) concurs with Arrighi (1967) and posits that the institutions in Rhodesia had a strong racial orientation that created no room for an African middle class, also influencing a deterioration of the peasant agriculture. This paper examines whether we can really talk about an African middle class in Southern Rhodesia by measuring the agricultural production in the NPAs using GIS and machine learning techniques. Additionally, the study tests whether NPAs located nearer to main high ways, railway sidings and major urban centres performed better than the rest to try and answer the question answer the question; 'to what extent did this infrastructure matter?'.

Towards Equalization of Farming Opportunities in Southern Rhodesia

Legislation Changes

There were attempts in Southern Rhodesia to equalise opportunities for all the races. This offers more reason to believe that this had a positive impact on the African middle class in the NPAs but more importantly, such manoeuvres had dire political consequences for their proponents as discussed later. Pollak (1975) indicates that the period 1945 to 1963 was characterised by reforms to alleviate the plight of the African farmer because Prime Minister Huggins eyed the formation of the Federation[4] of Rhodesia (encompassing Northern Rhodesia, Southern Rhodesia and Nyasaland). Thus, the conciliatory stance was important in convincing London, Lusaka and Blantyre to agree on Amalgamation, with the white dominated Southern Rhodesia being the power and administrative centre (Pollak, 1975).

As a result, the Native Production and Marketing Development Act (1949) and the Native Land Husbandry Act (NLHA) (1951) were the two pieces of legislation that aimed to make a positive review of the welfare of the Africans, although this was not successful (Duggan, 1980; Pollak, 1975). For the NLHA, it allowed too much monitoring and surveillance on Africans in the name on conservation practices promotion, while the marketing reforms were pinned on heavy taxes on the NPAs, whose real effect would essentially be subsidising the Reserves without any tangible benefits for the NPAs (Pollak, 1975). The NLHA brought in an individual land tenurial system with government support that increased government expenditure in African agriculture significantly (Duggan, 1980).

Duggan (1980) and Machingaidze (1991) indicate that the NLHA was meant to further consolidate the exploitation of the Africans, further reducing competition and guaranteeing a continuous supply of labour to industry. However, Stocking (1978) argues that the Act was a response to conserve ecosystems. From the point of view of Duggan (1980), the motivation behind this Act was to establish an African urban class and a rural middle class loyal to the state of Rhodesia, in addition to the need to meet the labour demands of industry by denying urban workers of land. The pretext of the colonial administration was the Land Husbandry Act intended to improve productivity of African agriculture (move towards more intensive agriculture) yet the Africans only had 30% of the area suitable for this kind of agriculture (Machingaidze, 1991). The purpose of this act was to reduce labour migration and to ensure

[4] This took place in 1953, and European agriculture became the responsibility of the Federal government while African agriculture was relegated to territorial administration.

that at 50% of the African adult male population was away working in the European Areas (Machingaidze, 1991).

However, Duggan (1980) offers the view that in the mid-60s, the NPAs accounted for a third of the African produce delivered on the market, yet they represented on 2% of Native households. Thus, the hypothesis of a well performing African middle class in the NPAs by Andersson and Green (2016) seem to hold. To support this, Pollak (1975) mentions that a significant portion of farmers in the NPAs were descendants of the *Fengu* - Africans who had migrated from the Cape together with the Pioneer Column and had to a large extent adapted the European way of life, farming methods and all. This paper tests whether NLHA assisted in conserving the NPAs and improving their production, or just consolidated the African proletariat class.

Creation of the African Farmers Union

Pollak (1975) makes reference to the work and lobbying effort of the African Farmers Union (AFU), that resulted in increased cooperation between the government and the NPAs. This culminated in some level of support by the government and in 1960, and the Native Farmers' Licensing Act was passed - allowing the AFU to collect 10 shillings mandatory annual subscriptions from every farmer and solving the financial handicap of the organization (Pollak, 1975). Coincidentally, in 1960 the AFU changed leadership and brought a more youthful, assertive and nationalist leader who envisaged to get the Land Apportionment repealed altogether (Pollak, 1975). This resonated with Prime minister whitehead, yet it created political disaster for the United Federal Party (UFP) (Pollak, 1975).

The Political Risk of Land Reform

The United Federal Party (UFP) party was sensitive to the plight of Africans. In the 50s, under Prime Minsiter Higgins and Todd, the colonial administration wanted to bring back competition between the races, increased expenditure on African agriculture, tried to promote African unionism, doubled the number of African pupils as well as introduced a multi-racial university (Arrighi, 1967). However, many of these proposals failed, and though African agriculture expenditure had risen, there remained double standards in as far as the treatment of the Europeans and Africans were concerned (Arrighi, 1966). In 1948, the UFP government set

up the Danziger Committee to deal with land issues (Nelson, 1982). The committee recommended that the native reserves no longer had the absorptive capacity for the additional people evicted from the white areas and 4 million areas of land were thus transferred to the natives under the designation Special Native areas (Nelson, 1982). Such transfers would soon be halted partly because of the boom in Virginia tobacco that created competition and exerted pressure on the few remaining unallocated land resources[5]. The other explanation for the halt in land transfers towards the Africans is that the UFP was treading a sensitive path by trying to reform the status quo of land distribution. This was a move that would spell political demise for the UFP because Europeans (the only class eligible to vote) represented an economic and power base that had vested interests to maintain the status quo.

Andersson and Green (2016), highlight that tension between European commercial farmers and the UFP government led to the coming into office of the RF. Christopher (1971) and Nelson (1982) posit that the 1962 elections had been contested around the issue of land and the RF had emerged victorious because they proposed a harder approach compared to the UFP's. As Nelson (1982) puts it, if the UFP had remained in power they would have amended or repealed the Land Apportionment Act so that 11%, 37% and 52% of the land would be allocated as national land, Tribal Trust Land and Land for All respectively as a way of encouraging multiracialism. Arrighi (1967) concurs with Nelson (1982), pointing out that a Select Committee recommend in 1961 the purchase of some European land for settlement by the Africans and the setting aside of a land reserve where all races could purchase land and the UFP party pledged to repeal the Land Apportionment Act in its entirety if voted into office.

The UFP was ousted from office by RF at the end of 1962 (Nelson, 1982). When the RF came into power they halted the land transfer to Africans program, finally abolishing it by 1969 (Nelson, 1982). The RF would create more apartheid policies, leading to the Unilateral Declaration of Independence (UDI) in 1975 (Andersson & Green, 2016; Christopher, 1971; Pollak, 1975). The entrance of the RF into government spelt an end to the support that the NPAs had started to enjoy (Duggan, 1980; Pollak, 1975). This again sparks interest to see how well the NPAs (the African middle class) was performing post 1962. Over and above that, the 1962 elections show that changing the status quo around the land is a political gamble, and it is likely that many present day governments in post-colonial states' slow approach to land reform reflects a risk-averse behaviour and fear of suffering the UFP fate.

[5] The unallocated land became fully used up in 1958 (see Nelson, 1982)

UDI and Liberation Struggle induced amendments

The Unilateral Declaration of Independence was declared by Ian Smith, the RF Prime Minister of Rhodesia on the 11th of November in 1965 - after negotiations to grant legal independence from the British government had failed to bear fruit since London's view of majority rule was an African led one as in other territories (Zvobgo, 2005). From Smith's point of view, UDI was an attempt to save Rhodesia from following the African majority rule trajectory that Northern Rhodesia (now Zambia) and Nyasaland (now Malawi) had taken in 1964 upon the collapse of Federation (Zvobgo, 2005). UDI attracted economic sanctions against Rhodesian and its international isolation (although it could still trade with South Africa). UDI could thus also have hurt production in the NPAs.

On the other hand, Herbst (1991) indicates that the racial veil characterising the land was removed through amendments to land legislation in 1977, although this did not have a lot of change because Africans still could not afford to purchase land in the European Areas. This paper also descriptively tests whether this had any effect on production in the NPAs.

Data

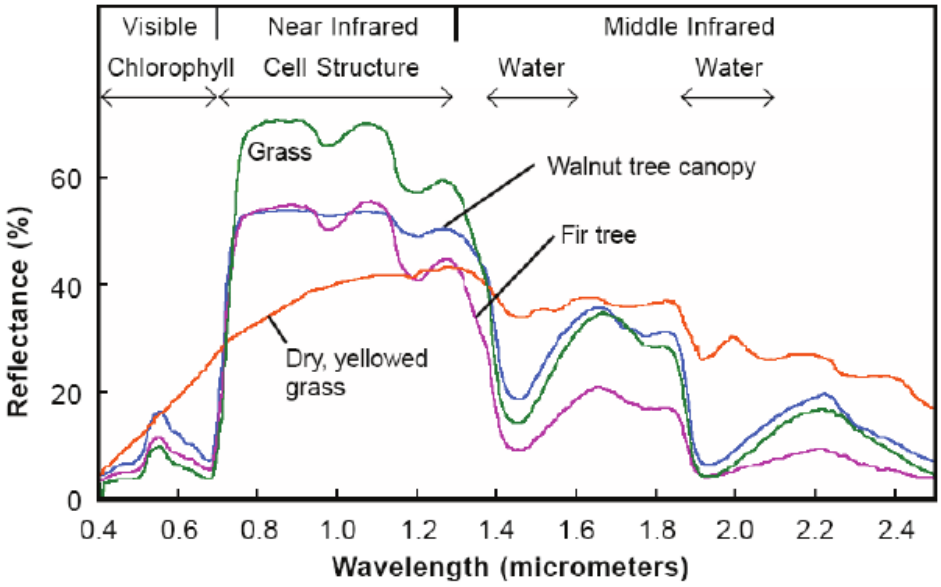
The closest classification of land cover work done early in the life of the Colony is the work by Robbins (1934) in neighbouring Northen Rhodesia. Robbins (1934) used aerial photographs taken at the altitude of 10000 feet by the Aircraft Operating Co. of South Africa. While, the main objective of the exercise was to assist in quicker area mapping, this study takes forward that work and classifies cropland in the NPAs using machine learning and images from the MSS sensor.

Classification of Images Using Machine Learning

When electromagnetic energy from the sun hits an object on the surface of the earth, some of that energy is reflected back to the satellite. There are bands of electromagnetic energy, with the most common being Red (R), Blue (B) and Green (G). These three are the ones visible to human eyes, yet there are several others. Of particular importance is the near infrared band that we cannot see but is reflected back to the satellite by crops more than any other objects on the earth's surface. Crop classification takes advantage of this, together with the fact that different

objects on the earth's surface have different spectral signatures of electromagnetic energy reflection (Chamunorwa, 2010; Eastman, 2003). Figure 5 shows different spectral signatures for various types of vegetation.

Figure 5 Spectral Signatures by Vegetation Type



Source: Govender, Chetty, and Bulcock (2007)

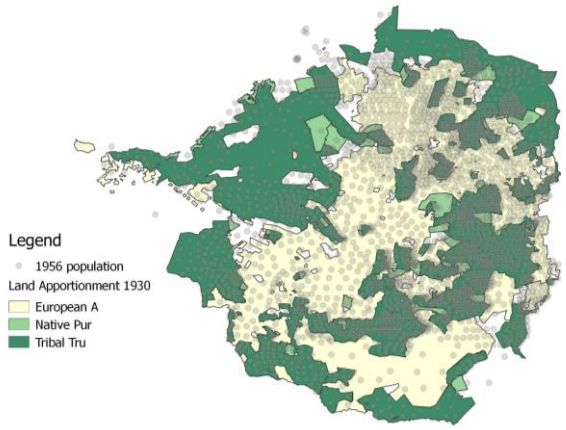
This study thus builds on the image classification work of Fernandes (2015), and uses the Support Vector Machine (SVM) algorithm [developed by Cortes and Vapnik (1995)] to classify image footprints (170071, 170072, 171071, 171072) from the Landsat 1 – 5 Multispectral Scanner (MSS) (see appendix 2). We employ supervised classification, where the train the samples used for predicting between cropland and natural forest in Quntum GIS (QGIS)'s SCP plugin. Final image classification in R produces a raster image with pixels 1 and 0 denoting cropland and natural forest respectively. The amount of ward land under cropland is then computed from these classified/predicted images.

Processing Variables in QGIS

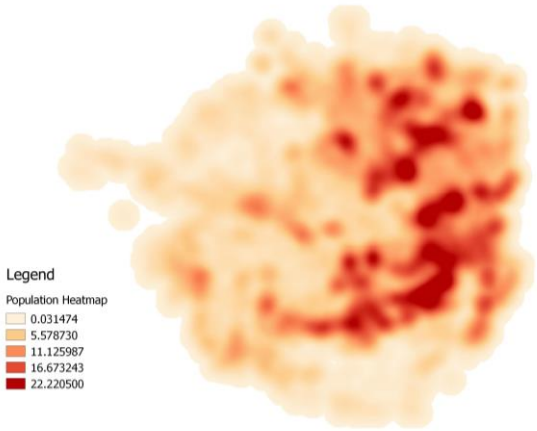
Apart from cropland hectorage endogenous variable, other variables such as population and distances to infrastructure are processed in GQIS. The map in Figure 3 is digitized to create main roads, secondary roads, any roads, rail stations and sidings and main cities shape file layers. These are then used to calculate distance to the nearest infrastructure variables from the centroid of each ward (see Appendix 2). The population point layer is created by digitising the population density map in Appendix 3. Each blue dot represents a 1000 Native heads of households. Figure 6 shows the land classes in Southern Rhodesia overlaid with the population heat map and population point layer. The heat map is created using the population point layer.

Figure 6 Land Classes Overlaid with Population Heat Map and Point Layers

Land Classes and Population



Population Heat Map

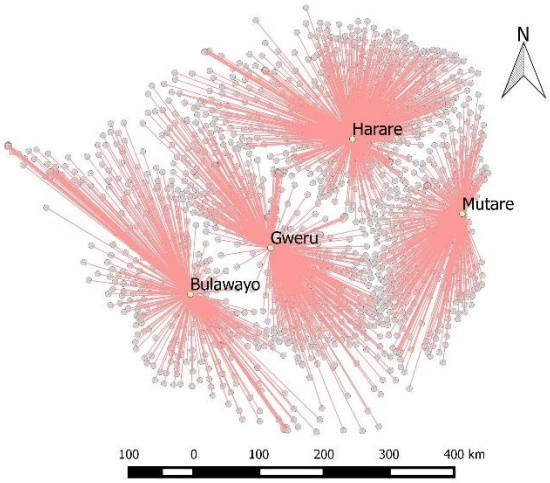


Source: Own Illustration

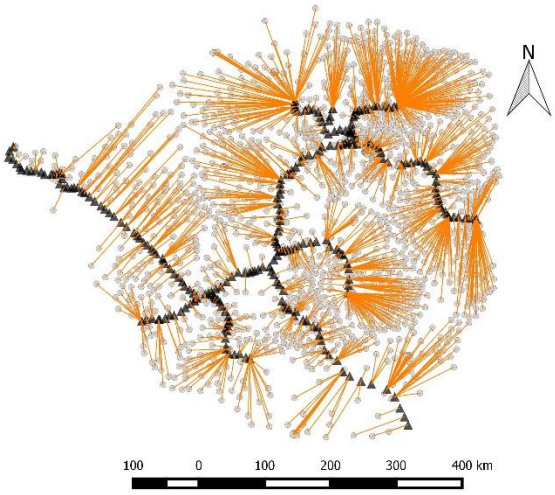
A visual of the distance variables created in QGIS is presented in Figure 7.

Figure 7 Distance Variables

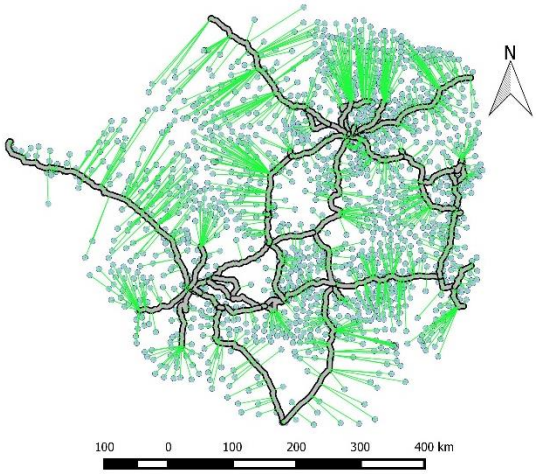
Distance to Main City



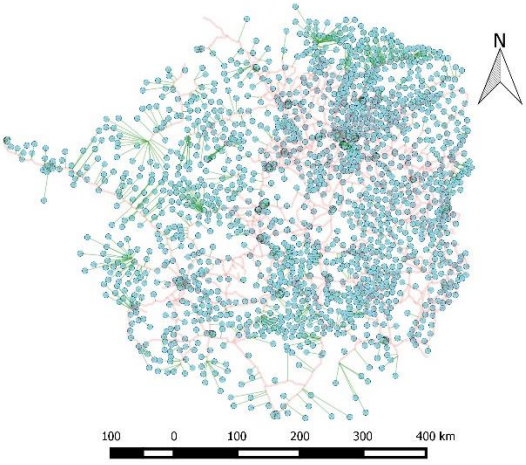
Distance to Railway Station or Siding



Distance to Main Road



Distance to Main or Secondary Road



Results and Discussion

This section descriptively tests the assertion whether farmers in the NPAs represented a well to do middle class. It also tests the effect of access to infrastructure on crop production in Southern Rhodesia.

Where NPA famers a Middle Class?

Figure 8 Bar Graphs of Crop Production by Class (1972 – 1984)

Crop Proportion **Total Crop Pixels**

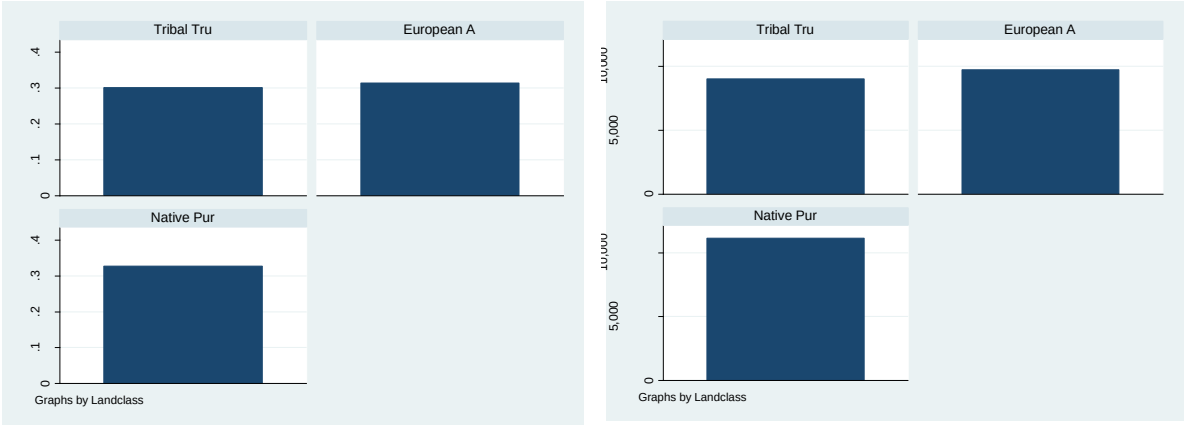
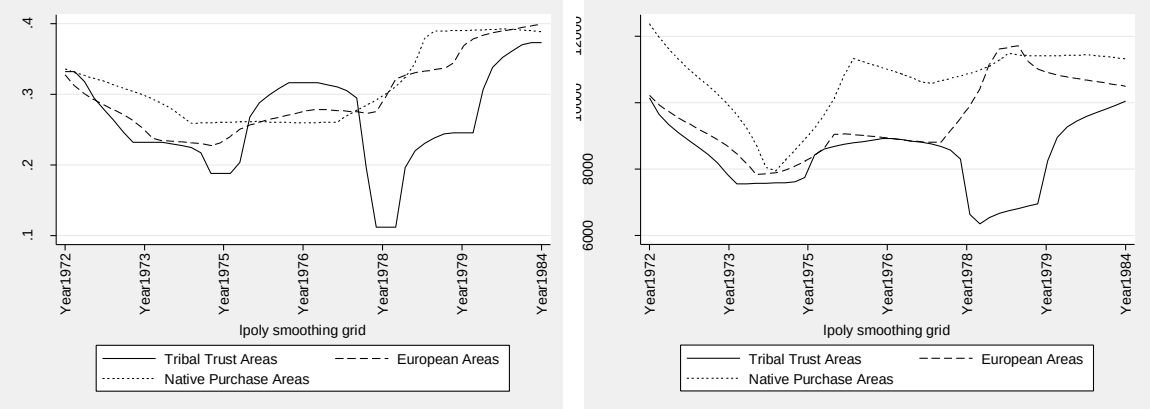


Figure 8, shows that for the years 1972, 1973, 1975, 1976, 1978, 1979 and 1984, NPAs seem to be outperforming the other land classes both in terms of the proportion of land under crops in a ward and in terms of the quantity of production (the total number of pixels under cropland). A similar trend can also be seen if Figure 9 is considered. However, it has to be noted that the crop production of NPAs is reported higher because the land demarcations as based on the 1930 Land Apportionment Act, do not fit perfectly with the Zimbabwe Census 2012 Ward Level shape file that our small area analysis is premised on. Preforming a spatial join of the Rhodesia land classes shape file (shown in Figure 6) and the 2012 ward level shape file enlarges the NPAs due to overlapping (see Figure 10).

Figure 9 Linear Polynomials of Crop Production by Class (1972 – 1984)

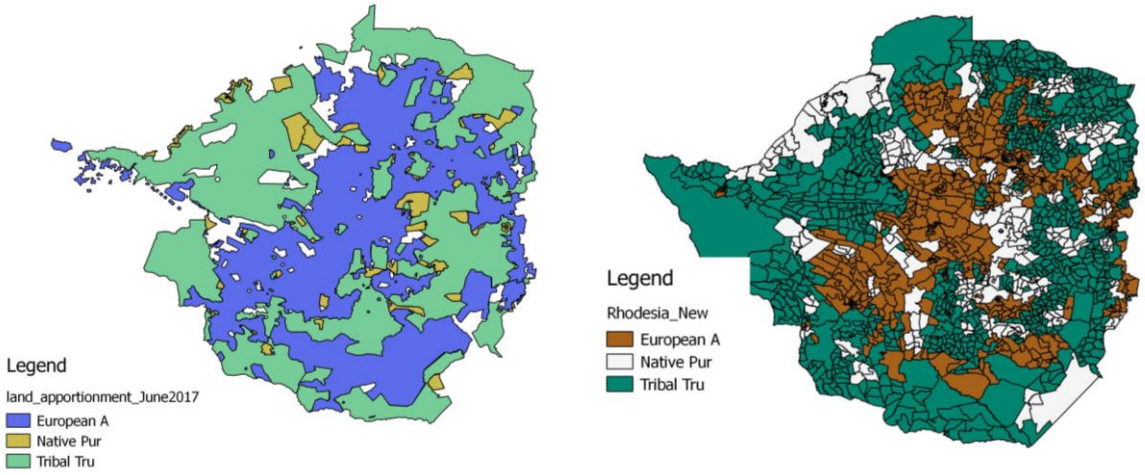
Crop Proportion **Total Crop Pixels**



Figures 8 and 9 seem to suggest that the NPA farmers were indeed a well to do middle class as asserted by Andersson and Green (2016). They seem to be outdo the African farmers in the Tribal Trust Areas (TTAs) and even their European counterparts in terms of crop production. However, it has to be noted that NPAs have been enlarged by the spatial join in QGIS as shown in Figure 10.

Figure 10 Enlargement of NPAs after Spatial Join

Original NPAs **NPAs after Spatial Join**



The Effects of Infrastructure on Crop Production

The study estimates OLS regressions to answer the question whether access to infrastructure has an effect on the crop production. The results are presented in Table 4.1. The endogenous variable is the ratio of cropland to total ward area. The main explanatory variables are Distance to Main Roads, Distance to Secondary Roads, Distance to Any Road, Distance to Main Cities and Distance to Rail Stations or Sidings. The control variables are Population, Rainfall, Temperature, Crop Suitability Index and Agrological Region Fixed Effects.

Table 4.1 OLS Estimation Results

Dep. Variable	**(1)**	**(2)**	**(3)**	**(4)**
Proportion of Cropland	b/se	b/se	b/se	b/se
1.landclass	0	0	0	0
	(.)	(.)	(.)	(.)
2.landclass	0.014	0.004	0.012	0.007
	(0.007)*	-0.008	-0.009	-0.009
3.landclass	0.027	0.028	0.027	0.028
	(0.016)*	(0.016)*	(0.016)*	(0.016)*
1.region		0		0
		(.)		(.)
2.region		0.057		0.086
		(0.021)***		(0.022)***
3.region		-0.004		0.013
		-0.021		-0.022
4.region		0.024		0.03
		-0.021		-0.022
5.region		0.009		0.008
		-0.022		-0.027
mean_pop			0.002	0.003
			(0.001)***	(0.001)***
l_rain			-0.003	0.001
			-0.004	-0.004
temperature			0	0
			(0.000)**	(0.000)**
l_mainroaddi			-0.007	-0.011
			(0.004)*	(0.004)***
l_secroaddis			0.001	0.005
			-0.004	-0.004
l_railsitan			0.005	0.011
			-0.004	(0.005)**
anyroaddis			0.001	0.002
			(0.000)***	(0.000)***
maincitydi			0	0
			0	0
AverageCal			0	0
			0	0
Constant	0.301	0.28	0.295	0.252
	(0.005)***	(0.020)***	(0.026)***	(0.037)***
R-squared	0.001	0.007	0.006	0.015
N	6411	6411	6376	6376
p-value	0.072	0	0	0

NOTES:* p<0.1, ** p<0.05 and *** p<0.01 denotes statistical significance at the 10%, 5% and 1% levels respectively.

Variables Rainfall, Distance to Main Roads, Distance to Secondary Roads and Distance to Stations or Sidings are transformed to their natural logarithms as a normalization strategy, and are thus interpreted as elasticities. Regression (1) seeks to establish the effect of land class of crop production. Tribal Trust Areas (TTAs) are treated as the base, and the regression coefficients of 0.014 for European Areas (EAs) and 0.027 for Native Purchase Areas (NPAs) show that EAs and NPAs were doing better by 0.014 and 0.027 average points respectively. The coefficients are statistically significant at the 1% and 5% levels respectively.

In Regression (2), Agro-ecological Fixed Effects (FEs) are added to establish whether the effect of land class remains robust, if we take into account the geographical advantages and disadvantages of particular agricultural areas. The effect of land class remains robust for NPAs, while it becomes insignificant for EAs. The same trend remains, when controls are added, and agro-ecological Fes excluded in Regression (3). In Regression (3), the mean population has a coefficient of 0.002, which is significant at the 1% level. Thus, the percentage of area used for crop production in a ward is positively related to the average population. This result may be indicate that the production of the TTAs was lower than other land classes due to the effects of the Land Apportionment Act (1930) which sought to deprive TTAs of labour by drawing especially the male African population to work in the mines, factories and European farms.

Distance to Main Roads has a coefficient of -0.007, significant at the 1% level. This implies that the further away from main roads farmers are, the less crop production they are able to engage in, although the effect is small. Distance to any road is also significant at 1%, although it has a positive coefficient of 0.001. This variable captures dirt roads, that would have been available in virtually every part of the country and the positive coefficient may proxy human settlement and related farming activities that would be inevitable. However, these low-level roads at the community level may not be important as a determinant of agriculture production, as also supported by the relatively smaller coefficient.

Other control variables do not have any significant effects. These are rainfall, temperature, average calories index, distance to secondary roads, distance to main city and distance to railway station/siding. In Regression (4), regional FEs are added back but the results of Regression (3) remain robust, save for the fact that distance to distance to nearest railway station/siding becomes statistically significant at 1%, although it has a positive coefficient of 0.011. This would imply that the further farmers are away from a railway station/siding, the

more crop production they would be involved in, which is not as expected since access to infrastructure to boost agricultural production.

Conclusion

Successful land reform goes beyond the quantity or fertility of the land, but has a lot do with the availability of labour and finance, access to markets and infrastructure. This paper showed that land reform is a high stakes game as the Federation Party (FP) did not only lose elections in 1962 because they wanted to repeal the Land Apportionment Act, but their demise also spelt the demise of a once prosperous Federation of Rhodesia and Nyasaland. As put across by Hughes (1971), any land reform which abolishes the existing form of social control has got very little chance of being accepted or to be successful, as this paper discusses using the 1962 election. The paper finds some evidence that the farmers in the NPAs were a well to do middle class since they were responsible for a significant amount of crop production in the colony. The regression results show that land class was important in Southern Rhodesia, and that the NPAs were doing better that the TTAs on average. Additionally, the paper finds that lack of access to infrastructure in the form of access to main roads negatively affected crop production in Southern Rhodesia; and the policy implication is that present-day governments may consider improving access to infrastructure for their previously disadvantaged communities because this is a factor that affects crop production and subsequently welfare.

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Appendix 1

Regression 1

```
. reg crp_mean i.landclass
```

Source	SS	df	MS	Number of obs	=	6,411
				F(2, 6408)	=	2.63
Model	.408114434	2	.204057217	Prob > F	=	0.0721
Residual	497.134801	6,408	.077580337	R-squared	=	0.0008
				Adj R-squared	=	0.0005
Total	497.542915	6,410	.0776198	Root MSE	=	.27853

crp_mean	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
landclass						
European A	.0135739	.0072152	1.88	0.060	-.0005703	.0277181
Native Pur	.0265138	.0160675	1.65	0.099	-.0049839	.0580114
_cons	.3005536	.0047284	63.56	0.000	.2912844	.3098227

Regression 2

```
. reg crp_mean i.landclass i.region
```

Source	SS	df	MS	Number of obs	=	6,411
				F(6, 6404)	=	7.63
Model	3.52931957	6	.588219928	Prob > F	=	0.0000
Residual	494.013596	6,404	.077141411	R-squared	=	0.0071
				Adj R-squared	=	0.0062
Total	497.542915	6,410	.0776198	Root MSE	=	.27774

crp_mean	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
landclass						
European A	.0035075	.0076006	0.46	0.644	-.0113921	.0184071
Native Pur	.0278503	.016093	1.73	0.084	-.0036974	.0593979
region						
2	.0567665	.020651	2.75	0.006	.0162836	.0972493
3	-.0035224	.0210659	-0.17	0.867	-.0448187	.0377739
4	.0241117	.0206004	1.17	0.242	-.016272	.0644953
5	.0086276	.0223522	0.39	0.700	-.0351902	.0524454
_cons	.2797173	.0201831	13.86	0.000	.2401517	.319283

Regression 3

Source	SS	df	MS	Number of obs	=	6,376
				F(11, 6364)	=	3.73
Model	3.17528911	11	.288662647	Prob > F	=	0.0000
Residual	492.507572	6,364	.077389625	R-squared	=	0.0064
				Adj R-squared	=	0.0047
Total	495.682862	6,375	.077754174	Root MSE	=	.27819

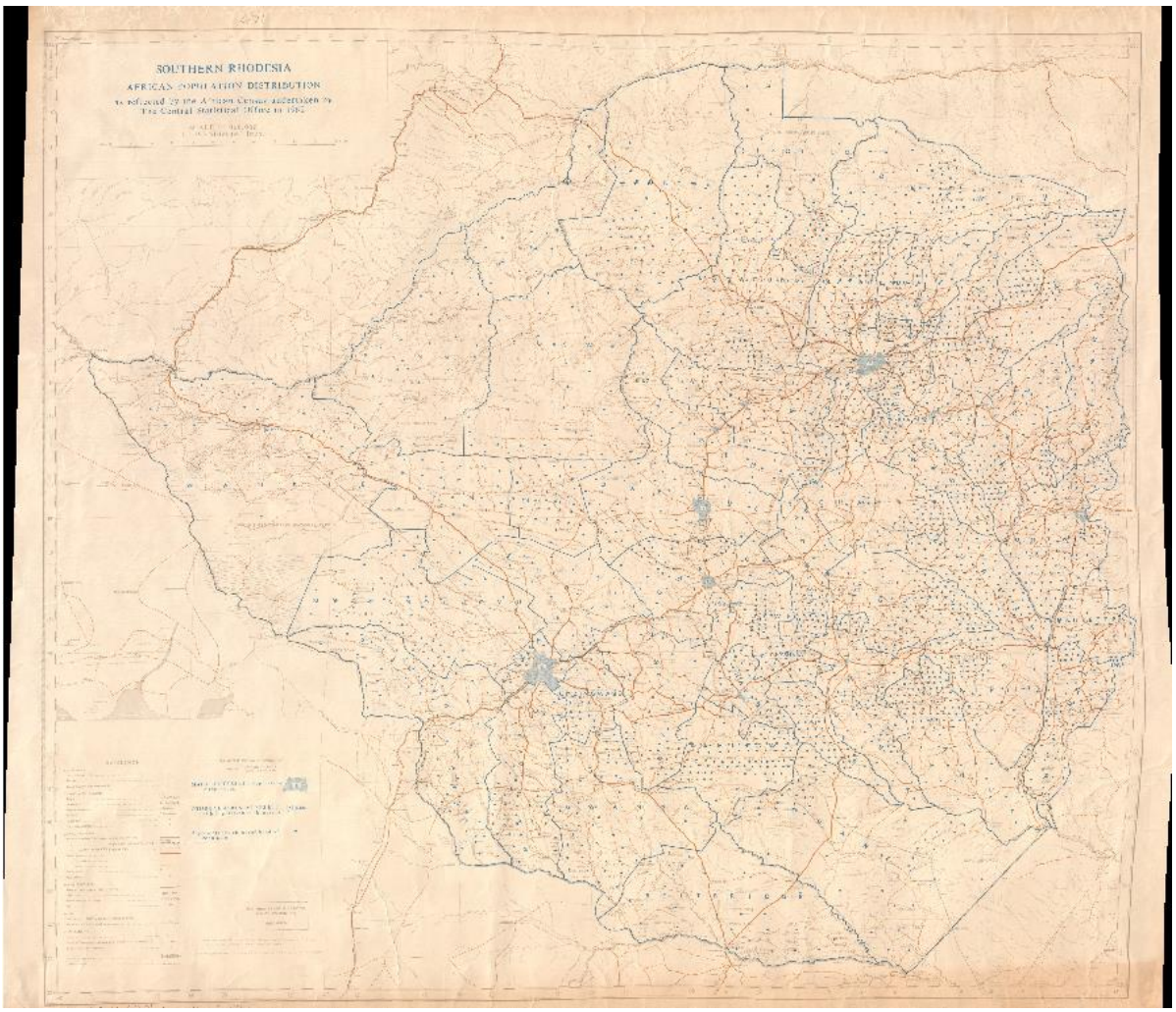
crp_mean	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
landclass						
European A	.0121304	.0091271	1.33	0.184	-.0057617	.0300226
Native Pur	.0269113	.0161577	1.67	0.096	-.0047631	.0585858
mean_pop	.0021874	.0005856	3.74	0.000	.0010394	.0033354
l_rain	-.0032195	.0036558	-0.88	0.379	-.0103862	.0039471
temperature	-.0002814	.0001427	-1.97	0.049	-.0005612	-1.68e-06
l_mainroaddi	-.0068298	.0040145	-1.70	0.089	-.0146996	.00104
l_secroaddis	.0013571	.003634	0.37	0.709	-.0057667	.0084809
l_railsitan	.0047526	.0044528	1.07	0.286	-.0039764	.0134817
anyroaddis	.0014565	.0004309	3.38	0.001	.0006117	.0023013
maincitydi	-.000108	.000066	-1.64	0.102	-.0002375	.0000214
AverageCal	5.51e-06	8.58e-06	0.64	0.521	-.0000113	.0000223
_cons	.2945558	.0263636	11.17	0.000	.2428742	.3462374

Regression 4

Source	SS	df	MS	Number of obs	=	6,376
				F(15, 6360)	=	6.47
Model	7.45314816	15	.496876544	Prob > F	=	0.0000
Residual	488.229713	6,360	.076765678	R-squared	=	0.0150
				Adj R-squared	=	0.0127
Total	495.682862	6,375	.077754174	Root MSE	=	.27707

crp_mean	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
landclass						
European A	.0070874	.0092584	0.77	0.444	-.0110621	.0252369
Native Pur	.0280667	.016155	1.74	0.082	-.0036026	.059736
region						
2	.0863709	.0220498	3.92	0.000	.0431459	.1295959
3	.0134403	.0220658	0.61	0.542	-.029816	.0566966
4	.0304654	.0222232	1.37	0.170	-.0130995	.0740303
5	.0075942	.0266049	0.29	0.775	-.0445603	.0597488
mean_pop	.002771	.0005947	4.66	0.000	.0016052	.0039368
l_rain	.0012767	.0036958	0.35	0.730	-.0059684	.0085218
temperature	-.0003486	.0001428	-2.44	0.015	-.0006286	-.0000686
l_mainroaddi	-.0110698	.0041109	-2.69	0.007	-.0191285	-.0030111
l_secroaddis	.004527	.003696	1.22	0.221	-.0027183	.0117723
l_railsitan	.0109531	.0046453	2.36	0.018	.0018468	.0200594
anyroaddis	.0015187	.0004304	3.53	0.000	.000675	.0023623
maincitydi	-.0000325	.0000711	-0.46	0.648	-.000172	.0001069
AverageCal	-.0000153	.0000107	-1.42	0.155	-.0000363	5.78e-06
_cons	.2520006	.0374394	6.73	0.000	.1786068	.3253945

Appendix 2: 1956 Population



Source: Federal Department of Trigonometrical and Topographical Surveys, Rhodesia and Nyasaland (1956). Available online at: http://www.digitalcollections.lib.uct.ac.za/special-collections-maps