Electoral Competition and Deforestation: Micro Evidence from Kenya

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August 2011

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Abstract

In states which are characterized by weak democratic institutions, leaders can play upon ethnic identities to elicit support by making transfers of resources. Closed canopy forests of Kenya has suffered severe destruction since the early 1990s. In this paper I bring new evidence to investigate whether the sudden introduction of multi-party elections (in 1992) into Kenya during the Moi regime (1979-2002) raised political motives to allow districts access to government forest land. Closed canopy forests in the *forest reserves* of Kenya are owned and managed by the central government. I create two novel data sets to understand the issue. One, I create using Landsat satellite imagery a panel data of forest cover at the constituency-year level. Two, to uncover the possible mechanisms, I assemble a detailed panel data of forest land allocations by the government. Satellite imagery reveals that deforestation increased after the introduction of multi-party politics. This has been driven by more deforestation in loyal districts and little in opposition districts. The government allocation data shows that after 1992 forest land has been primarily transferred for private use (to individuals/communities) rather than for public use (e.g. building schools). Further, within the private allocations it is land used for squatter settlements that has increased since the introduction of political competition. Lastly, I find a correlation that in swing districts that greater access to forest land leads to higher votes for the ruling party in the next election. The findings sheds light into understanding how weak institutions can lead to pathologies in resource allocation.

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`If the Attorney General cannot prosecute known land-grabbers and the ordinary citizen lacks the locus standi to take such cases to court, who will save Kenya?`

- Wangari Maathai (1997)

`Recent forest loss has resulted from government approved, politically motivated, and dubiously legal excisions of forest land from protected areas, reserves and plantations.`

- World Resource Institute (2000)

1 Introduction

Weak political institutions can lead to pathologies in resource allocation and there is increasing appreciation of what these are and how they arise. In Africa, there are various manifestations of weak institutions, but the issues are country specific and need to be studied case by case. One particular form of weak institutions is the single-party state. Until the 1990s the predominant African political system was single-party states. As Besley and Kudamatsu (2007) show, while in some contexts autocracy has produced good economic performance, in Africa it has consistently been dysfunctional. During the 1990s there was a wave of democratization as more than half of the African countries held multi-party elections. Given the dismal record of autocracy, it was naturally assumed that introduction of political competition would achieve both legitimacy and accountability, and thereby improve economic performance. However, there exists little empirical micro evidence on the effect of democracy on development and this evidence remains inconclusive.[1] This paper tries to understand how the institutional change of introducing political competition impacted the management of government land in particular forest land.

There is a large body of literature on the causes of democratization in Africa (see for instance Van de Walle (2002)). But little is known on how this institutional change affected the ruling party's management of economic resources to elicit support in the presence of ethnic division. There are many aspects of policy that can be studied as a consequence of this institutional change. I focus on the management of closed canopy forest which are owned and managed by the Government of Kenya in what are known as *forest reserves*. Sustainable management of forests lies at the intersection of the core environmental agenda (water resource degradation, climate change and deforestation) not only for the Kenyan context but also for the global climate change agenda. The UN rates Kenya as having one of the lowest natural water replenishment rates in

[1] Kudamatsu (2006) measures development outcome as infant mortality and shows that, in Africa, multi-party democracy produced no improvement except in the rare instances in which the incumbent was defeated. Recent empirical work (Collier and Rohner, 2008; Collier and Hoeffler, 2008) confirms that for low levels of development democracy significantly increases proneness to civil conflict, and that in resource-rich economies with weak checks-and-balances electoral competition worsens economic performance.

the world and classifies it as a chronically water-scarce country. In addition Kenya is vulnerable to rainfall variability. This in turns affects the country's foreign exchange earnings due to it's high dependence on water-dependent cash crops (e.g. tea, coffee, horticulture) and hydroelectricity provision World Bank (2006). Further, reducing emissions from deforestation and forest degradation in developing countries is considered to be a potentially effective low-cost strategy to mitigate climate change (Stern 2006).[2] I am able to overcome a key data constraint in monitoring resource allocation. Official statistical data from government ministries on expenditures and allocations are often manipulated, aggregated at a regional level, inconsistent with other sources and in some cases not even recorded let alone updated. I use Landsat satellite imagery to observe forest cover changes. Landsat satellite imagery provides a precise picture of global land cover and land use over the last three decades.[3] I extract from raw Landsat satellite imagery a panel data set of forest cover to track the evolution of the forest cover during Moi's regime (1978-2002). Satellite imagery can depict deforestation but cannot reveal the ultimate purpose or the user of the cleared forest land. I provide evidence on the mechanism by assembling a novel Government of Kenya forest land *excision* data set to create a district-year level panel. This unique data set has the *universe* of all excisions that occurred on forest land during the Moi regime.[4]

There are four key reasons aside the issue of access to data that Kenya can be seen as a typical Sub-Saharan country (i) introduction of multi-party politics in 1992 was sudden and forced on by the conditions set by the Paris Club of donors for continued access to aid money; (ii) the nature of administrative geography, ethnicity and politics in Kenya. District administrative boundaries determine ethnicity and ethnicity is salient when it comes to politics. Voting in Kenya is primarily along ethnic lines and party labels serve to indicate ethnic groups (Throup and Hornsby, 1998); (iii) the economic resource under study is owned by the government. Closed canopy forests are primarily inside the *forest reserves* of the government's Forest Department. The management of the Forest Department and in turn the forest reserves is top-heavy and weak on accountability. Governance of forest reserves has changed very little since 1963. In particular they remained intact during the transition to multi-party democracy in 1992; (iv) the identity of political leaders may matter for policy-making.[5] During the transition to multi-party the same leader (Daniel Arap Moi) remains in power, hence the concern of different policy preferences due to change in personnel can

[2]Under the Kyoto Protocol, the Clean Development Mechanism and Joint Implementation, reducing deforestation has played a limited role in mitigating climate change. The 2007 conference in Bali however has warranted the need to look into reducing deforestation as a possible option for the post-2012 global climate policy framework.

[3]The fundamental objective of the Landsat acquisition has been to obtain images on a global basis repetitively and under near identical atmospheric and plant physiological conditions (USGS 2005).

[4]Excision is a legal term used in land allocations in the Kenyan context. I use the word excision and allocation interchangeably. Excision in this paper is simply the reduction of land area from the forest reserve. This can be done legally, through a notice in the *Kenya Gazette* and Legal Notices (*de jure*) or in practice (*de facto*). Details in Institutional Background and Data section.

[5]There is a growing number of empirical studies that provide evidence for this hypothesis. See Jones and Olken (2005), Pande (2003) amongst others.

be eliminated.

My empirical methodology uses the unique features of administrative geography, ethnicity and politics in Kenya. I use the ethnic demography of Kenyan districts to classify them into their political alliance (opposition, swing and loyal) towards the ruling party. This is the cross sectional variation I exploit. The analysis is then to follow and compare the trajectory of these different types of districts before and after the introduction of democracy.

My findings are as follows. Firstly I find an increase in the annual loss of forest cover after the introduction of democracy. This is robust to including constituency fixed effects, controlling for general time trends and population. The satellite imagery reveals that this acceleration occurs differentially across the three different types of districts. In particular swing and loyal districts seem to suffer more deforestation. The excision data then helps to unveil the possible mechanism of the destructions observed in the satellite imagery. In particular simple difference estimates reveal that (a) there is 65% increase in the amount of land excised after the introduction of democracy (b) forest land used for the public good (e.g. building schools and churches) has increased by 63% whereas for private use (squatter settlement and individual allotment) there has been an even larger increase (83%) (c) I find tentative evidence that the central government allocated more forest land to swing districts for the purpose of private use than it did before the introduction of democracy (a 130% increase) (d) a large increase is also found in forest land access to loyal districts for the use of the public after the introduction of democracy (168%) (e) no such significant difference between pre and post democracy is observed in the loyal districts on access to land for private use and (f) and no significant difference in access to forest land is found for opposition districts between the transition to democracy both in the use of public or private use allocation. These findings tie up with the satellite imagery evidence as both loyal and swing districts have experienced deforestation. Lastly, if forest land allocations are meant to help in building political support then a crude test would be to look at electoral data. I find that in swing districts greater access to forest land correlates to higher votes for the ruling party in the next election.

The findings from this research speaks to various literature. It adds to a large empirical literature that tries to identify the effect of democracy on development. The evidence shows one facet of how democracy functions and its consequences in a state with weak political institutions. Further, the study speaks to a growing literature on ethnic politics and patronage which has primarily been descriptive and theoretical. The findings speak to the workhorse redistributive politics model (core-supporter or loyal voters) and political agency models (e.g. Padró i Miquel, 2007). The main novelty of the research is to bring new evidence to first monitor resources (satellite imagery) and secondly to understand the purpose behind the destruction (excision data) in both spatial and temporal contexts.

Encroachment in the Kenyan forests has been widely reported both in the popular press

as well as in the international media as the two quotes illustrated at the beginning of the paper.[6] Policy work by the United Nations Environmental Program and the Kenya Forest Working Group has mentioned on numerous occasions that there is increasing damage to the natural forests. This work is one of the first systematic quantitative studies in Africa that tries to understand the effect increased political competition on the environment.[7]

The rest of the paper is organized as follows. The next section discusses briefly the related literature. Section 3 describes the institutional background. Section 4 details the data. Section 5 provides the empirical analysis and discussion of the results. Concluding comments are offered in Section 6.

2 Related Literature

The distributive politics problem is a classic study in political economy with a long and mature branch of scholarship. There are many previous contributions looking at both the theoretical and empirical distributive politics problem, too many to mention exhaustively here.

The literature provides two basic and opposed models of political resource allocation in the presence of electoral competition. The first of the models are called the "core-supporter" models. This has been developed by Cox and McCubbins (1986), they divide the electorate into three groups - core supporters (loyal districts), swing voters and opposition backers. The question then is which of these groups should be the main beneficiaries of targeted transfers to maximize the probability of being elected. These groups, according to the model, differ in what makes them more or less responsive to a transfer. Core voters are most responsive because parties know their preferences and desires well. These core voters will be allocated redistributions. Swing and opposition backers are riskier bets. A second set of models predict that politicians should avoid loyal supporters and instead target "swing voters" (Lindbeck and Weibull, 1987; Dixit and Londregan, 1996). The Dixit and Londregan (1996) model begins by asking whom politicians running for office would target with discretional transfers. Voters' utility is modeled as a function of issue positions and transfers. The parties' issue positions are assumed to be fixed, while tactical reallocations of the budget are relatively flexible. In the Kenyan context, issue positions is the ethnic identity while the party symbols and access to forest land are the transfers. The model uses the probabilistic voting framework of Lindbeck and Weibull (1987) and predicts that politicians should favor swing voters.[8]

These two ideas of distributive politics have been widely tested primarily in the US with a

[6] Wangari Maathai was awarded the Noble Peace Prize in 2004 for her efforts to fight the Moi regime against destruction in the closed canopy forests, see Maathai (2006). Repercussions of the damage to the closed forest in the 1990's is currently reported in the international media, *Financial Times* Special Report on Kenya [28/08/2010]; *The Independent*, UK [24/08/2009]; CNN Special Edition [22/10/2009] amongst others.

[7] Boone (2009) and Kloop (2000) are two pieces of political science work that discuss political motives on land allocations in Kenya.

[8] Under the assumption that politicians' transfers can be equally targeted to all voters.

focus on distribution of government spending, as shown in the review of the literature in Larcinese, Snyder and Testa (2006), empirical support for the idea that swing voters are targeted is mixed (Londregan, 2007). There is evidence for both, one that supports the swing voter hypothesis (Schady, 2000; Dahlberg and Johanson 2002; Stokes, 2005) and the other that finds consistent support with the core or loyal voter hypothesis (e.g. Calvo and Murillo, 2004; Hiskey, 2003; Case, 2001; Levitt and Snyder, 1995). There is a tendency in the literature to portray the redistribution decision between core and swing voters as a binary choice.

Empirical evidence in this paper does not fit directly into either of the two workhorse models of distributive politics. I find evidence that resource transfers are occurring to both the loyal districts as well as to swing districts. This evidence can be reconciled with recent contributions in the political economy field, I briefly highlight three of them. In terms of distributive politics the findings can be reconciled with those of Besley (2007), who develops an approach to political equilibrium in a two-party setting. The approach characterizes political resource allocation as trading off the utility of core party supporters and swing voters. The key finding is that there is no simple prediction, rather it depends on the profile of swing voters and the extent of a party's underlying political advantage. This makes intuitive sense, as political parties are motivated both by long-term objectives - to maintain their political support over time (as partisan loyalty is not unconditional)- and short term objectives to expand their base especially at times of elections (attract swing voters). Hirano et al (2009) offer another explanation, whereby they model electoral competition with primaries. The addition of primary elections allows them to tease out the finding that transfers should be taking place to core supporters. Intuitively, the core supporters are the first hurdle to cross before the general election. It is then not surprising that transfers occur to loyal supporters as they have the leverage to influence who would then run for the general elections. In the Kenyan context this fits perfectly well; primaries are held by the parties before the general elections. Another class of models in the political economy literature that can shed light on my findings are political agency models. In particular, the model sketched by Padró i Miquel (2007) applies to my context - ethnic divisions and weak political institutions. In his setting loyal backers of the regime do receive transfers and even though this transfer might not be much, they are larger than they would be if a regime switch occurred. This ties with my findings of transfers of forest land being made to loyal supporters.[9]

3 Institutional Background

There are four key ingredients to understanding the context.

[9]Note that the Padro i Miquel (2007) model does not make a distinction between democracy or autocracy and hence could be applied in my case.

3.1 Political History

The period of study for this paper is 1979-2002, which is the entire period Daniel Arap Moi was president.[10] Multi-party politics was introduced in 1992. In 1978 upon the unexpected death of the first president Kenyatta, Moi came into power.[11] Moi found challenges from factions of the Kikuyus within the party to allow for opposition party formation, he acted swiftly to convert the status quo of the *de facto* one party state to *de jure* one party state by passing Section 2(a) in 1982.[12] The strong central government (civil service) that Moi had inherited from Kenyatta was dismantled and instead he strengthened the party machinery.[13] During the Moi era effectively all powers were centered in the Office of the President, e.g. all decisions had to be sanctioned by the Office even if the cabinet had agreed. This was in contrast to the Kenyatta-era whereby the Office of the President was a small entity and had a limited role to play. The late 1980s and early 1990s saw a rise in personalization of power by repressing and silencing opposition politicians, trade unions and students. In November 1991, at the Consultative Group meeting in Paris, donors decided to suspend new aid and balance of payment support of $315 million until the regime reformed its political system.[14] Within *two weeks* Moi informed KANU that the party would have to repeal Section 2(a) and allow the formation of other political parties. Political scientists claim that the primary factor that drove donors to suspend aid assistance and trigger the sudden introduction of democracy was the fall of communism in Eastern Europe and the end of the Cold War (Throup and Hornsby, 1998; Bratton and Van de Walle, 1997). The end of the Cold War increased the West's bargaining power to demand an end to single party authoritarian regimes on the continent.[15]

3.2 Electoral System

I next discuss how exactly political competition changed when democracy was introduced in 1992. Kenya has a presidential system with a first past the post election procedure. The country is divided into single-member constituencies in which all adults can register to vote and candidates can stand in any constituency. Constituency is the unit of political competition whereas administrative units

[10] Briefly, Kenya gained its independence from Britain in 1963. Soon after independence its first president, Jomo Kenyatta, dismantled the quasi-federal constitution inherited from the colonial era to establish a Republic with a strong central government. The central government was powerful at the expense of both the parliament and the sole political party, Kenya African National Union (KANU). As a result a *de facto* one-party state emerged in Kenya under KANU.

[11] Moi came from a small ethnic group (the Kalenjins, who represented around 11% of the population) and was not as charismatic as Kenyatta. Kenyatta hailed from the largest tribe in Kenya, the Kikuyus (20%). In addition to being a natural orator he was seen as a fatherly figure due to his fight for independence against the British during the *Mau Mau* revolution.

[12] The one sentence amendment was as follows "There shall be in Kenya only one political party, the Kenya African National Union".

[13] See Widner, (1992) for a detailed description of the rise of the one-party state.

[14] Donor aid funded nearly 30% of the government's expenditure during the 1980s and 1990s.

[15] The early 1990s saw more than half of the fifty-two African governments introduce multi-party elections.

of the country in order of size are Provinces and Districts.[16] Districts can contain more than one constituency. In the single-party era, *all* aspirant candidates had to be life members of the sole party (KANU), and had to be cleared by the party. Political competition took place at the constituency level through the KANU primaries. A number of candidates from within the party would stand up to represent the constituency. The winner of these primaries, one per constituency, would also be declared to be the member of parliament for that constituency in the National Assembly. As in most one-party systems, the President was usually chosen by the central committee of the sole ruling party and then voters usually gave the yes-or-no vote. In Moi's one party-era (1979-1991) he was re-elected unopposed in all the elections. The presidential ballot had never been held and the outcome of presidential elections was always known in advance. The executive seat was never contestable and never challenged. The only electoral contest that took place was on who would represent the constituency in parliament. These contests occurred regularly, every five years.[17] The introduction of multi-party elections was to change the nature of electoral contests. Political competition now occurred simultaneously on two levels: the national level for the executive and the constituency level for parliamentarian representation. In reality, the space of political competition for both the presidential and parliamentary contests is at the national level during multi-party elections as party labels now signalled national coalitions (Posner, 2005). The Moi regime won the 1992 election. Though the elections were not free and fair on several grounds, the primary reason why the regime could not be overthrown was the lack of a strong unified opposition (Kimuli, 2005). The next multi-party elections in 1997 were also won by Moi, this time even more convincingly as the party machine had resorted to silencing the opposition. Moi stepped down eventually in 2002 when he was constitutionally barred from participating in the elections further this time around the opposition united to pitch one candidate.

3.3 Ethnicity: Administrative Geography & Voting

Ethnicity is determined by geography in Kenya and ethnicity is salient when it comes to politics. The geography of ethnic groups in Kenya reveal that they are clustered into administrative districts. Hence district administrative boundaries, which are the unit of analysis in the study, are close markers of ethnic groups. The colonial British created administrative boundaries [districts (41) and provinces(8)] by the Regional Boundaries Commission of 1962 which originated from Proclamation No. 54 of 1924. This Proclamation fixed the province boundaries and in majority of the cases the names used were the ethnic groups (e.g. Kikuyu Province had the Kikuyus, Maasai Province had the Maasais, etc). The creation of these districts as ethnic units can also be visualized. For instance, a simple exercise of overlaying historical district boundary maps on the 1988 ethnic population census map shows that (i) post-independence district boundaries have remained stable for nearly thirty

[16] The other smaller ones are - Divisions, Locations and Sub-Locations.
[17] Widner (1992); Posner (2005).

years (until 1992) and (ii) between 1992-2002, the number of districts have increased to around 70 (see Figure 1).[18] The GIS exercise shows that the increase post-'92 has primarily occurred to obtain additional political support in the ruling party's area. Kasara (2010) argues that the former single-party used district creation in the democratic era to retain power and purchase support. I use the 1988 district boundary changes for all analysis. I will discuss the use of the 1988 boundaries later.[19] In essence, the current province boundaries reflect a deliberate attempt by the colonial administration to institutionalize these ethnic groups and this has persisted (see Oucho (2000) for a discussion). This is well documented in Lord Haileys's survey (1950) of native administration in British Africa. Appendix table 10 reveals descriptives of the ethnic groups in Kenya in a spatial context. I find that the largest five ethnic groups have their own homelands. The Central province is dominated by the Kikuyus, the Nyanza Province is dominated by the Luos, the Western Province is dominated by the Luhyas, the Eastern Province is dominated by the Kambas and the Rift Valley is dominated by the Kalenjins.

In Kenya people view their political representatives as sources of patronage (Barkan, 1976 and 1979) and assume that having a member of their ethnic group in a position of political power will increase their access to state resources (Posner, 2005). Voting in Kenya is primarily along ethnic lines and party labels serve to indicate ethnic groups (see Fox (1996), Throup and Hornsby (1998), Posner (2005) and Gutiérrez-Romero (2010) using the Afrobarometer surveys). The main parties contesting in the 1992 elections were:[20]

Kenya African National Union (KANU), the ruling party throughout my period of study, 1978-2002, led by Moi, a Kalenjin hailing from the Baringo district of the Rift Valley. It's vote base is primarily the Rift Valley.

Forum for the Restoration of Democracy Kenya-Asili (Ford-A) led by Matiba (a Kikuyu) whose main support was his homeland areas of the Central Province and parts of Nairobi.

Forum for the Restoration of Democracy-Kenya (FORD-K) led by Odinga (Luo) with its main support base in the Luo land of Nyanza.

Democratic Party (DP) led by Kibaki (a Kikuyu), with its support base in the other half of the Central province.

Voting results of the 1992 multi-party elections show that parties drew upon their regional bases (in fact Barkan and Ng'ethe (1998) describe these elections as sets of geographically distinct

[18] I have created GIS files of all the boundary changes for which maps were produced - 1909-1918-1924-1929-1933-1961-1963-1969-1979-1989-1999 and overlayed these on the 1988 district ethnic census. Not all figures are reported for reasons of space.

[19] See Ominde (1968) for historical discussion of boundary changes.

[20] Four other parties took part in the 1992 elections. I do not discuss these parties as they are very small and in total the four as a group obtained 0.7% of the national votes.

one-party-dominant contests). Appendix table 12 illustrates that voting outcomes at the province level are strongly ethnic. Roughly 96% of the votes in Central Province (predominately Kikuyu province) supported the two Kikuyu parties, DP and FORD-A. Equally high share of voters in Luo-dominated constituencies of the Nyanza Province supported Odinga's FORD-K.

3.4 Governance of Forest Reserves

In Kenya, land is divided into three different legal categories: Government Land, Trust Land and Private Land.[21] The majority of closed canopy forest land is gazetted as *forest reserves*. These are land areas that have been surveyed, demarcated on the ground and declared as forest reserves. They are legally owned by the Government and are managed directly by the Forestry Department under the Ministry of Environment and Natural Resources on behalf of the State.[22] All satellite imagery and excision data obtained focus on the forest reserve's belonging to the government. In particular these forests are climatically restricted to the Central Highlands and the Nyanza Plateau, in areas below an altitude of $3,000$ meters.[23] Appendix table 13 outlines the percentage of areas of closed canopy forest under the different land tenures and its management authority. During the period of study, forest reserves were governed through a national forestry policy implemented through the Forest Department and the Kenya Wildlife Survey (KWS). Although the legal provisions for protection and management of the environment is scattered in 77 statutes, legislation concerning forests is fairly comprehensive for forest reserves. In particular the forest reserves on Government land are under **Forests Act (cap** 385**,** 1962**, revised** 1982**)**[24] This is a parliamentary Act for the preservation, protection, management, enforcement and utilization of forests and forest resources on Government land and is applicable to forest reserves. **Section** 4 of this Act allows (de) gazettment of forest reserve, further the Minister of Environment (appointed by the President) may from time to time by notice in the *Kenya Gazette*: (i) declare any unalienated Government land to be a forest area (ii) declare the boundaries of a forest and from time to time alter these boundaries (iii) declare

[21] Land classification for the country as a whole is as follows: 78.5% is under Trust Land, 20.0% is Government Land and 1.5% is Private Land (Republic of Kenya, 2000). This is in line with many parts of Africa where about 60% of land is under indigenous forms. In the Kenyan context, Government land includes both *alienated* and *unalienated* land. Alienated land is land that has been set aside for a specific purpose. Unalienated land is legally owned by the Government but has not been set aside for a specific purpose. Trust land includes the former Native Reserves which were set aside by the British for the natives. Forest on Trust land means that the land is held in trust on behalf of the local people by the County Councils.

[22] A small percentage of closed canopy forest are also managed by the Kenya Wildlife Service (KWS) and some are gazetted as National Parks and National Reserves managed by KWS, and National Monuments managed by the National Museums.

[23] I abstain from analyzing and discussing riverine and coastal forests known as mangrove forests. This is because (i) these are data limitations - satellite images are often cloud covered near the coast region and (ii) coastal mangroves occupy only 5% and riverine forests occupy less than 1% of closed canopy forest.

[24] Kenya's first comprehensive forest legislation was the Forests Ordinance of 1941. In 1964, the Forests Ordinance was amended and adopted as the Forests Act (Cap. 385). Since then legislation has received only minor amendments, mainly with regard to rules made by the Ministers in charge of forests as provided for in section 15 of the Act. The Act states that `forest area means an area of land declared under Section` 4 `to be forest area.`

that a forest area shall cease to be a forest area, known as *excision* (iv) before a declaration is made 28 days notice of intention to make the declaration shall be published by the Minister in the *Kenya Gazette*.

The law also provides that before the area(s) intended for excision is excised it must be surveyed and approved by the Chief Conservator of Forests. The forest land is deemed excised after the expiry of the 28 days notice, through issuance of a Legal Notice by the Minister as an official government directive that the forest land has been excluded from the remaining forest area and is officially and legally excised. There was no requirement of the law for the Minister to give any reasons for such declarations outlined above. Further, the law did not require the Minister to have any reference to any of the shareholders or any consultations. In fact the responsibility of the forest was fully in the whims of the government and in particular the Minister.[25] It is clear from the above that there is little if any accountability in the management of these forest reserves. These gazette notices are the only official tool for communicating the gazettment or de-gazettment of forests. It is important to note that the power granted to the Minister to declare the area as forest or not is not absolute. The final power is in the hand of the President. According to the **Government Lands Act (cap** 280**, revised** 1984**)** under **Section** 3 the President has the power to

> `make grants or dispositions of any estates, interests in or over alienated Government land`

This Act provides unlimited power to the President in land allocations. The President by appointing the Minister of Environment can without any substantial accountability allocate forest land.[26] Note, legislation governing forest reserves have remained intact during the transition to multi-party democracy.[27]

4 Data

4.1 Satellite Imagery

The Government of Kenya publishes a Statistical Abstract every year which details a section on forestry. This forestry section reports two figures, the total amount of closed canopy forest cover in the country and the amount of forest the government owns. Figures 2 and 3 display this information. Both of the figures are informative, there is no timely updating of this information to date. Thus

[25] See Okidi et al (2008) for details.

[26] This was one of the key findings highlighted in the *Report of the Commission of Inquiry into the Illegal/Irregular Allocation of Public Land* which took place in 2004 after the succession of Moi by Kibaki.

[27] In November 2005, a new Forest Act 2005 was ratified but it was only in late 2007 that it was formally passed through parliament and implemented in the Laws of Kenya. See World Bank (2007).

accurate and timely data on the extent of deforestation in Kenya does not exist to undertake the research question. I create a historic dataset of forest coverage from Landsat satellite imagery. The advantage of using remotely sensed imagery is that they provide a comprehensive picture of the changes on the ground that captures encroachment of the forest. This removes any form of manipulation had government sources been used. The data is constructed from processing raw satellite images from the Landsat Global Survey Mission. It is widely agreed in the remote sensing literature that Landsat images of high resolution are the best tools for identifying and measuring deforestation (Asner, 2001; Ju and Roy, 2008). This is especially true for countries with a low percentage of land under forest cover (De Fries et al, 2007).

Landsat satellites scan the Earth's surface across a pre-planned track over the sunlit side of the earth over a regular revisit interval. As the satellite moves along a particular path, the instrument scans the terrain below, each of the continuous data streams is framed into individual scenes of approximately 185 km by 180 km according to the World Wide Reference System (WRS). The WRS is a grid of paths and rows overlaid on a map of the Earth; the intersection of the path and row are used to identify Landsat images to catalogue the scenes. The WRS allows me to identify the images I need access to cover all of Kenya's closed canopy forest in the forest reserves. In order to locate where forests are I use the Government of Kenya's Topography maps completed in the 1970s which were based on ground assessment and aerial surveying.[28] In total nine scenes are required to cover the spatial spread of Kenya's forest reserves; see Figure 4 for an illustration, and Appendix Table 14 lists **all** the raw images available for Kenya for my study period 1979-2002. These are all cloud free images which the US Geological Survey acquired and are available for public use. Unfortunately, I do not have access to a *balanced panel* of satellite imagery scenes. The unbalance is both in the cross-section and yearly availability of scenes. The reason for the unbalance is not due to sample selection, i.e. the Kenyan government has not restricted access. It is primarily due to the persistent cloud cover near the equator year round. This is the main challenge in constructing forest cover data from remotely sensed imagery. As a result I have imagery access for only restricted time periods pre- and post- the introduction of political competition in 1992. These are the years $1986-1988$ and $1989-1991$ prior to the arrival of political competition and three time periods after (1995, 2000 and 2001).[29] The various routines to run on satellite images for extraction of forest cover at the constituency-year level is detailed in the Data Appendix under Satellite Imagery.

The process outlined in the data appendix for the satellite imagery is repeated for each of the 36 cloud free images across the period 1979-2002. Figure 5 displays the false color composite images upon which the maximum likelihood classification is run to extract forest cover and figure 6 shows that encroachment can be detected from these images. Table 1 outlines the number of constituency-year points my satellite image yields. The main variable I construct from the satellite

[28] I scan, geo-reference and digitize 275 topography maps for this exercise.

[29] IImagery is obtained during the dry season.

imagery is total amount of forest cover for constituency in a given year. Table 1 reveals that I have in total 197 observations for 48 constituencies across my sample period. Further, the number of observations I have pre-1992 is 60 and post-1992 is 137. These 48 constituencies span 22 districts.

4.2 Government Excision Data

I now describe the government excision data on forest land that I collate for the period 1979-2002. These are firstly all the gazette notices published in the *Kenya Gazette* which take place in forest reserves (recall that the Minister of Environment is legally bound to put a notice in the gazette when forest land ceases to be forest land). The primary source for this information is each gazette publication. I obtain access to all gazette notices. I cross-check this information with various sources to ensure I have the universe of **all** excisions (see Data Appendix for details).

On completion of the steps outlined in the data appendix I am able to create a *excision-district-year* panel which contains the variables (i) the year of gazettement/allocation, (ii) the district where the forest is, (iii) the amount of land excised (in Hectares) and (iv) the purpose of the excision. Descriptive statistics on the data reveal that in total I have 222 excisions taking place in 26 districts over the period 24-year period (1979-2002).[30] The "purpose of the excisions" lists 8 different categories. Namely these are forest land to County Council, Church building, School building, Government use (e.g. setting up transmitters), National Parks, land to individuals and land for settlement of squatters.[31] As I have valid reasons to believe that I observe the universe of excisions, a non-occurrence of an excision in a *district-year* is also information. By using this information I can create a *balanced* panel data set. This rectangularization of the data results in having 624 *district-year* observations (26 districts across 24 years).

I re-classify the category of excisions into a dummy variable taking value one if the land use is for private and zero if it is for public. The original categories are now subcategorized into land for public use (which includes school, church, National Park, etc) and land for private use (individual allotments and land for settlement of squatters).[32] The new land use category reveals that 42.40% of excisions were for public use and 58% were for private use in the 1979-2002 Moi period. Hence I know for a district-year how much public and private excision there was. The key outcome variable of the excision data set is total amount of land (log hectares) excised during year t in district d, ($S_{d,t}$).

[30] My satellite imagery data has only 22 districts - I will discuss the two samples later in the paper.

[31] The percentage of each category is as follows: County Council (10%), Church (2%), Government use (12%), National Park (2%), Individual allocation (27%), Settlement of squatters (30%) and Schools (16%).

[32] Initially I had conducted analysis splitting by categories but the small sample lacks power in regression analysis.

4.3 Population Census & Voting

In 3.3 I discussed (i) district administrative boundaries as close markers of ethnic groups and (ii) ethnicity as salient when it comes to voting. Table 2 tabulates all the districts that have forest land and their ethnic demographics.

Analysis in this paper focuses on using the pre-democracy district boundaries of 1988 which delineates 41 districts. There are three reasons for this choice:

1. The last ethnic census done at the district level was conducted in 1989 using the 1988 boundaries. I use this census to classify districts as being loyal, swing or opposition.

2. If one displays the 1988 GIS district map and the 1999 district map it is clear that new districts have been created primarily in the stronghold areas of the ruling party to further consolidate power (only 1 official district map has been produced by Survey of Kenya in 1999 between 1989-2002). This suggests possible patronage at work. As well as the fact that post-1992 changes are related to increase support which is also correlated with increased use of forest land.

3. Third, these new district boundaries that have been created are typically created haphazardly. No document or official source exists which informs the changes in a systematic way that can be followed up by a researcher.

In particular I use the 1989 Population Census to splice Kenyan districts into their political alignment (opposition, swing and loyal) towards the ruling party. I briefly summarize my classification using party labels to serve as ethnic groups and the ethnic census:

1. Classifying loyal districts is straightforward. The ruling party's (KANU) homeland is the Rift Valley province. The Rift Valley districts which have a high concentration of Kalenjins are labeled as loyal districts. Further, within the Rift Valley there are tribes which have been historically close to the Kalenjins. These are the Masai, Somali, Turkana and Samburu tribes. Districts with a high share of these ethnic groups (50% plus) are labeled as loyal.

2. Classifying districts into opposition is also straightforward. Central province districts would never back the ruling party as they have their own party (there were two Kikuyu parties). Neither would the Embu and the Meru tribes as they are close to the Kikuyus and are often collectively know as GEMA (Gikuyu (Kikuyu), Embu and Meru Association) hence the Embu and Meru districts are assigned as opposition districts. Laikipia provides an interesting setting even though it is located in the Rift Valley province it is assigned as opposition because of the large presence of Kikuyu settlers from Nyeri district which it borders. Bugoma district is Luhya territory which had the FORD-K as its party and is classified as opposition.

3. Swing districts: Kakamega and Busia are both in Luhya land but have the non-Bukusu Luhya tribes; Nairobi is highly cosmopolitan with none of its ethnic community commanding majority share; Kamba community (Kitui and Machakos districts) did not have any particular inclination to any ethnic group and so were considered as swing (discussion in Throup and Hornsby, 1998). The rest of the districts in the Rift Valley province (Nakuru, Trans Nzoia, Uasin Gishu and Narok) are the only districts where the Kikuyus and the Kalenjins meet in large numbers and thus are classified as swing.

Note, my classification of political alignment is constructed at the district level but elections are fought at the constituency level (there are typically 3/4 constituencies per district). As ethnic census is obtained at the administrative level of district, this makes my measure noisy as I am aggregating and diluting the level of competition within a district. On the other hand as districts are quite homogenous this is not a concern.

To validate my classification of districts I use the 1992 presidential electoral data to construct three different political competition measures. This will allow me to see how they fare with my classification. Table 3 tabulates two measures. The first row is the mean share of votes the ruling party (KANU) obtained in 1992. This is split by different types of districts as shown in the columns. Loyal districts (column 3) show strong support (90% votes on average) to the ruling party, whereas opposition districts (column 1) show the least amount of support (10% on average). Swing districts are in between the two extremes (at 45%) suggesting some level of competition occurring in these districts. My second measure (row 2 of the table) is the measure $(Winner - RunnerUp)_{d,1992}$ which is the difference in vote share between the winning and losing party in district d. Again it is clear that the loyal district outright supports the ruling party and that other parties obtain very few votes (column 1). In swing districts (column 2) the gap is the narrowest, suggesting that competition occurs. In the opposition district as there is more than one party competition (recall their are two Kikuyu parties for instance) the gap is narrower than in the loyal areas but much more than in swing districts. Lastly I create a political competition measure which is measured as $p_{d,1992} = -|V_{d,1992} - 0.5|$ where $V_{d,1992}$ denotes vote share of the ruling party's votes (KANU) in district d secured in the 1992 multi-party elections. Due to the negative sign, higher values of $p_{d,1992}$ denote more political competition. A kernel density plot in figure 7 for the three types of districts show that swing districts have the highest amount of competition distributed (density on the right with a higher mean than loyal or swing). It shows also that there is little competition in the loyal and opposition districts. This provides a sense check on my classification.

5 Empirical Analysis

The empirical analysis is organized as follows. I first discuss my methodology. I then document evidence from satellite imagery. To understand the possible political motives behind forest land

destructions I discuss evidence from the excision data. Finally, I tie up the excision evidence with electoral data to see if this had any impact on gaining political support.

My empirical methodology uses the unique features that intertwines administrative geography, ethnicity and politics in Kenya. I use the ethnic demography to splice Kenyan districts that contain closed canopy forest into their political alliance (opposition, swing and loyal) towards the ruling party. This is the cross-sectional variation I exploit over time. The analysis than is to simply follow and compares the trajectory of these different type of districts before and after the introduction of political competition. The outcomes of interest are forest cover (from satellite imagery) and amount of land allocated as excision out of the forest estate (government excision data).

My empirical methodology is based on two assumptions (i) the introduction of democracy in 1992 is exogenous to the pre-existing trend in the destruction of forest cover and (ii) no other changes occurred at the same time as the introduction of democracy which happened differentially along the political alignment of the district (opposition/swing/loyal).

Assumption (i) does not seem implausible in light of the discussion set out in section 3.1. The introduction of democracy was primarily driven by factors outside Kenya. Assumption (ii) on the other hand is potentially problematic. It is useful to discuss the variation that I am exploiting to pin down potential econometric concern. I exploit cross-sectional variation in the political alignment of the district to the ruling party (this variation comes from an understanding of ethnic politics in Kenya). This implies any omitted variable (observable and unobservable) that is correlated with political alliance and affects forest cover differentially pre- and post 1992 would contaminate the effect. On the other side, any omitted variable uncorrelated with political alignment would not be problematic. Note that in this setting as I am controlling for district fixed effects this soaks up all unobservable time invariant characteristics. Hence, the concern that remains is the time-varying variables that are correlated political preferences. These are challenging to rule out.

Other, simple challenges exist. For instance, the introduction of democracy could come with a host of institutional changes such as new legislation on forest reserves and change in the decision maker as the incumbent could be replaced. My setting allows me to mitigate some of these concerns as the same leader Moi is in both pre and post the introduction of multi-party democracy in 1992 and legislation governing forest reserves does not change during the introduction of democracy.

5.1 Satellite Imagery

The objective of table 4 is to simply observe the evolution of forest cover. A trend break model over the study period 1979-2002 is estimated for constituency c in year t as follows:

$$f_{ct} = \alpha_c + \beta_1 t + \beta_2 D_{1992} + \gamma p_{dt} + \delta[t \times D_{1992}] + \varepsilon_{ct} \tag{1}$$

where f_{ct} is constituency c's forest cover (in logs) in year t. The α_c accounts for permanent differences across constituencies such as initial forest stock, a general time trend t to capture the rate of deforestation over the whole sample period and D_{1992} is a dummy variable equal to one if the year t is greater than 1992. Therefore, this dummy turns on if the year is after introduction of democracy, p_{dt} is log population for district d in year t, $[t \times D_{1992}]$ is a post-1992 time trend to capture rate of deforestation after democracy was introduced and ε_{it} is the error term clustered at the district level. I gradually build up the columns for 1 in Table4. Column (1) shows that the average amount of forest (log) before and after 1992 is smaller. This holds up when I control for constituency fixed effects and in fact most of the variation is absorbed (the R-sqr is now 0.98) by controlling for constituency time-invariant unobservables. This suggests that not only in general is there less forest cover before and after 1992 but this holds across all constituencies. Without controlling for any other variables column (2) suggests that there has been a 67% loss in cover between before and after 1992.[33]

Although time invariant unobservables are now controlled for, time-varying variables remain a concern which affect forest cover and the introduction of democracy. The main concern on land and in particular forest land is population pressure. In general, communities living within 5 km of the forest boundary make most use of the forest resources. It is the peripheral forest areas that are most heavily used, again generally within 5 km inside the forest boundary. The implication of this is that individual forests have to be over 8,000 ha in area before they can have a real chance of maintaining an undisturbed core zone. In all but the largest forests, the pressure exerted by the surrounding population is high. It is estimated that 2.9 million people, representing 530,000 households, live within 5 km of forest areas. Hence it is important to control for population. Once I control for population at the district level (linearly interpolated across the decadal census years), column (3) shows that in fact population pressure is driving forest clearance to a large extent.[34] The elasticity is large, a 1% increase in population growth in a district results in 0.8% reduction in forest cover. The coefficient on D_{1992} is now insignificant. This is not completely surprising given that population pressure causing land clearance is mentioned several times in Kenya. Column (4) includes a general time trend; as the forest might have some natural rate of growth it is important to control for this. The trend seems flat and population pressure still seems to be the key driver of forest cover reduction.

Column (5) adds a trend break post-1992, to see if there is anything else beyond population growth driving the loss in forest cover. The findings suggest that controlling for population which is driving a large part of forest reduction there seems to be a **larger decrease in forest cover**

[33]This is obtained by noting that the regression is semi-logarithmic. The 67% is obtained as follows - $ln(1+g)$ where $g = [(Y_1 - Y_0)/Y_0]$ where Y_1 and Y_0 are values of the dependent variable when the dummy variable is equal to one and zero, respectively.

[34]Ideally I would like to control at the constituency level. However, population census are not conducted at the constituency level. Recall politics is run at constituency level but administration of the country is at the district level.

post-1992. The calculated implied effects after 1992 suggest that this decrease is negative and significant.

Clearly from table 4 I do not aim to establish causality; while this is consistent with the story that the introduction of democracy led to an accelerated deforestation there are various alternative explanations. I have simply only looked at the time-variation, the passage of time and its effect on forest cover. Further, these results have to bear in mind that I cannot establish where exactly the trend break occurs. My cloud-free satellite imagery does not have many time period pre and post-1992. The years I have before 1992 are 1986-1987-1989-1991 and after are 1995-2000-2001-2002 (it is a unbalanced panel). Hence the trend break could have happened anytime between 1991 and 1995.

If there are any political motives at play it would be interesting to investigate whether the trend break post-1992 is heterogenous across districts which differ in their political alignment. Table 5 documents this. Column (1) simply shows the main result from Table 4. Columns (2)-(4) fit the same specification as column (1) but on different sets of sample (hence the smaller number of observations across the columns). Note that here too I estimate the forest cover to decrease post-92 in all samples. The total post-92 effect is calculated $\beta_2 + [\delta \times t]$ where t is the number of years that have passed since 1979. I report these implied effects (calculated using the delta method) for the year 1993, 1997 and 2002. The following can be inferred from these sub-sample results: (i) there seems to be no significant deforestation after 1992 in opposition districts. Interestingly, population does not seem to be driving loss in forest cover in the opposition districts; (ii) forest cover loss seems to have increased after 1992 in swing districts and population pressure seems to be an important driver; (iii) in loyal districts there was been an increase in deforestation rate after 1992, note that this is after fixing population.

In column (5) I run a triple interaction inorder to test whether the effects are significantly different from zero. Results show that loyal districts experience more forest cover loss post 1992 compared to opposition districts [t-test for the equality of post-92 trend break of loyal district and opposition district is rejected at p-value 0.08]. The point estimate of the triple interaction of swing is negative but not significant (-0.032). However it is larger by nearly three times to the opposition (-0.012) district. It is clear from this table that there does not seem to be an increase in deforestation in the opposition districts. Further, in loyal districts there is more deforestation than in opposition districts. With regards to swing districts a reduction in forest cover is marginally found. Due to the low sample size no concrete patterns of forest cover in swing districts can be inferred. Column (6) limits the sample with loyal and opposition districts only; similar results to column (5) are found.

5.2 Government Excision Data

Summary statistics of the excision data are stark, as tabulated below:

Period	No. of Excisions (average)	Total size, Ha (average)
1979-1992	84 (6)	51,873.24 (3,705.23)
1993-2002	139 (14)	117,853.83 (11,785.38)

Yearly plots of this information can be seen in figure 8, this shows that there are more excisions and they happen more frequently after 1992. With regards to the total size of excisions every year, figure 9 shows that there are larger excisions after 1992.[35]

The summary statistics corroborate the figures and illustrate that after 1992 there were more excisions in total; they happened more frequently and with more amounts excised. In Table 6 simple mean differences show that there is 65% increase in the amount of land excised after the introduction of democracy. Further, both land for public use and private use increased in the transition to democracy. More excisions for private use than they were before 1992 took place (up 83%). There was also an increase in land for public use (up 63%).[36]

Table 7 checks the robustness of the findings in Table 6 in a regression framework. Column (1) replicates the finding in Table 6, column (1) where we saw that on average there was more allocation of forest land after 1992 than before. Controlling for district fixed effects the findings remain robust (column 2). One of the findings from the satellite imagery was that population pressure has a large impact on the loss of forest cover. I therefore control for district level population throughout. Column (3) shows that population pressure can, if at all, only explain a small part of the increase in forest land allocations. I include a general time trend (column 4) to control for other omitted time-varying country level policies that might be driving the increase in forest land allocations (e.g. growth of the economy, structural changes). Results in column (5) show that this does not account for the estimated increase in land excisions around 1992. The findings from columns 1 through 5 are hence consistent with the story that forest land has been used increasingly for political reasons after 1992. Note that these allocations are done in Nairobi with little consideration of the population living in those areas. If population was driving allocations it would suggest that the regime was responding to real demand for land - however column (4) does not suggest that. This is an interesting finding as satellite imagery showed that population pressure was driving destruction. But when it comes to allocating forest land the regime does not seem to take into account the population pressure.

Columns (5) and (6) present results from the same specification as in column (4) on two different sub-samples. I find that for the average district there is no increase in forest land allocation

[35] If we tie this up with what the Government of Kenya reveals in their Annual Statistical Abstract the findings are stark. Figure 2 and 3 show that neither the amount of closed canopy forest cover has changed nor has the amount of forest the government owns.

[36] These percentages are obtained by noting that the regression is semi-logarithmic. The respective %'s are computed as follows - $ln(1+g)$ where $g = [(Y_1 - Y_0)/Y_0]$ where Y_1 and Y_0 are values of the dependent variable when the dummy variable is equal to one and zero, respectively.

for public use after 1992 (column 5). On the other hand the average district now has access to more forest land for private use after 1992 than before (column 6).

Table 8 documents means excision data pre- and post 1992 and for private and public use, similar to Table 6, but now splits the districts by their political alignment to the ruling party. At the aggregate level all the three types of districts obtain access to forest land (column 1). The mean differences are large for all but so are the standard errors. Column (1) does not distinguish between the type of forest land allocation. Columns (2) and (3) split the purpose of excision into two types of use - public and private. Using simple mean differences I find that opposition and swing districts do not experience more access to forest land for public use after 1992 than they did before. However loyal districts experience a large increase in access to forest land for public use post 1992 than they had before (a) 168% increase. Column (3) shows that swing districts get allocated much more access to forest land for private purpose post 1992. No such significant increases are found in access to forest land for private use after 1992 in the opposition or loyal districts.

Lastly, if forest land allocations are meant to help in building political support, one crude test would be to look into electoral data. A natural question to ask would be: does more forest land allocation result in more political support? In table 9 I present cross-sectional regressions of districts to investigate whether there is a link between total land given to a district and how they voted for the incumbent ruling party in the 1997 general election. Column (1) shows there is no relationship between the average total excisions for the period 1993-1997 and the average vote share difference between the multi-party election held in 1992 and the one held in 1997. Sub-sample analysis by type of district is presented in columns (2)-(4). There is no relationship between giving land and obtaining vote for districts that are loyal (column 4) and those that are opposition (column 2). However there is a positive and significant correlation for swing districts (column 3). In column (5) a full sample regression is run with interaction of the districts' political alignment and the total size of excision (between the year 1993-1997) and vote difference (1997-1992). Results show that F-test on the equality of the coefficient between swing district and opposition districts and swing district and loyal district are rejected at the 10% level. The positive correlation between the amount of total land given between 1993 and 1997 and higher votes gained by the ruling party (KANU) in swing districts in 1997 provides evidence that access to forest land was used, and successfully so, after the introduction of multi-party democracy to buy votes in swing districts.

5.3 Discussion

Summary of Evidence

Satellite imagery evidence showed that deforestation has increased during the post-1992 period. This is not a causal claim - a mere observation on the evolution of forest cover. Looking more closely at the different types of districts (loyal, swing, opposition) satellite imagery finds that there

is a clear distinction in the change of forest cover between loyal and opposition districts - loyal districts suffer more deforestation than opposition. The evidence for swing districts is weak. This might partly be due to the small sample size I have.

There are several findings from the excision data: (i) the central government post-92 excised more land (65% increase) than they did before; (ii) both land for the use of the public and land for private use increased. In particular, land for the use of the public has increased by 63% whereas land for private use had an even larger increase (83%); (iii) I find tentative evidence that the central government allocated more forest land to swing districts for the purpose of private use than it did before the introduction of democracy (a 130% increase); (iv) a large increase is also found in forest land access to loyal districts for the use of the public after the introduction of democracy (168%); (v) no such significant difference between pre and post democracy is observed in the loyal districts on access to land for private use; and (vi) and no significant difference in access to opposition districts is found between the transition to democracy both in public use or private use allocation.

Lastly, I find that in only swing districts there exists a positive correlation between the amount of land allocated during 1993-97 and more votes in the 1997 elections. These findings tie up with the satellite imagery evidence as both loyal and swing districts have experienced deforestation.

Concerns & Robustness Checks

Satellite Imagery

The first evidence presented was from satellite imagery using the trend break model. Given the nature of the research question, did the introduction of political competition in 1992 have an impact on forest cover? Satellite imagery provides a precise, unbiased data source to investigate this question. The challenge is access to cloud-free images. Due to frequent year-round cloud cover, it is challenging to find adequate images for a long time period pre- and post-1992. Ideally falsification exercises, e.g. lead and lag the trend break, to investigate when exactly the trend break identified in Table 4 occurred would be useful. However, my data only allows me to find that a break occurs at some point between 1991 and 1995. Given that I have the exhaustive Landsat imagery archive for Kenya during the period 1979-2002 it not possible to construct a yearly panel.[37]

Excision Data

The excision evidence documented in the empirical part focused on one variable S_{dt}, the size of the excision in district d in year t. I also construct a second measure, the number of excisions N_{dt} in district d in year t. Upon repeating the previous analysis I find that the number of excisions yields similar results. Time-series plots of excisions displayed that post-92 there was an increase in the number of excisions as well as in the size of excisions and frequency (figures 9 and 8). It is however

[37] Lower-resolution imagery such as data from MODIS/AVHRR which is 8 km in resolution would not suffice for this exercise.

not clear when exactly this increase in excisions occurs in the post-92 window. Had this started before 1992 or did it start much later? As my excision data is yearly panel it is possible to answer this question. I plot yearly coefficients from a regression with the dependent variable being S_{dt} on year dummies, district fixed effects and log $pop_{d,t}$. I cluster the standard errors clustered at the district level. I also do a similar exercise with N_{dt}. Figures 10 and 11 present the coefficient estimates on the year dummies. Both figures tell an interesting story. Prior to 1992 there is little activity both in the number of excisions as well as in the size of excisions. There seems to be a gentle cyclic pattern in size and somewhat in the number of excisions. There is one "odd" observation prior to 1992 - the year 1988. The raw data reveals that the year 1988 had four large settlements (each roughly 4,000 ha in size). Both figures show that after 1992 there is a discontinuous increase of excisions. This is supportive of the political motives at play as this change coincides with the introduction of political competition. Post 1992 there is much more activity both in terms of number of excisions and in the size of them: an amplified cyclic pattern of the pre-1992 is observed. Another concern is with regard to my assumption of covering the universe of excisions. Without this assumption it would not be possible to treat districts without excision data in a year as having not experienced any excisions. This is a strong assumption I am willing to make, given my exhaustive search. If for some reason that is not true, working on the unbalanced panel provides similar results in terms of magnitude. However, precision is often lacking, which is not surprising given the small sample size.

Sample

To tie the evidence across the data sources, satellite imagery and land excision data, it is important to note that my excision data contains an additional four districts (all in swing districts) for which I have no satellite imagery (see Appendix table 15 for the sample comparison). I repeat all the analysis dropping the four extra districts I have in the excision. Results are similar (not reported for space) in terms of qualitative findings and magnitudes but sometimes the precision is lower due to the lower sample size. Further, I ensure all my analysis from the excision data is on the closed canopy forest to maintain consistency with forest imagery. Thus, excision data from the Coast Province which contains riverine forest is excluded from the analysis.

Ethnic Census

A potential concern with the classification of districts into the political alliances is migration. Are the ethnic clusters subject to frequent migration? If that is the case than classifying the districts using the ethnic composition is meaningless. Because the cross-sectional variation that I exploit assumes that these ethnic groups do not migrate. To make my case that migration is not a concern I use the decadal population census at the province level. In particular appendix table 10 provides some support that there has been little migration of these ethnic groups. The ethnic shares of the main groups within provinces (these groups cover more than 75% of Kenya's population) have not

seen any substantial changes across the different census waves (1969, 1979 and 1989), suggesting a vast majority of the population resides on their ancestral land. Simply tabulating the national share of each ethnic groups across the three decadal censuses waves (appendix table 11) would not address the issue of migration even though shares of groups have remained stable.[38] Statistics on ethnic composition, migration and religion are extremely sensitive in Kenya because group size determines the legitimacy of claims to resources. As mentioned the last publicly available ethnicity census is the 1989 census. There is some controversy surrounding the release of these data as they were realized five years after collection. It was believed that the census was manipulated to show a larger share of the Kalenjins. I repeat my analysis using the 1979 and 1969 ethnic census as well as I construct district fractionization scores using all the census and they are remarkably similar.[39]

6 Concluding Comments

During the 1990s there was a wave of democratization as more than half of the African countries held multi-party elections. Given the dismal record of autocracy, it was naturally assumed that this institutional change would achieve both legitimacy and accountability, and thereby improve both political and economic performance. I use satellite imagery and government excision data to present new evidence on the use of forest land to elicit political support in an ethnically divided society. The main novelty of my approach lies in the data I obtain to understand this issue.

Satellite imagery evidence showed that deforestation has increased during the post-1992 period. Looking more closely at the different types of districts, satellite imagery data shows that there is a clear distinction in forest cover loss between loyal and opposition districts. Loyal districts suffer more deforestation that opposition. The excision data shows that the central government post-92 excised more land than they did before. Both land for the use of the public and land for private use increased, with private use increasing more in the democratic period. I find tentative evidence that the central government allocated more forest land to swing districts for the purpose of private use than it did before the introduction of democracy. A large increase is also found in forest land access to loyal districts for the use of the public after 1992. No such significant differences between pre and post democracy are observed in the loyal districts on access to land for private use and no significant difference in access to opposition districts is found between the transition to democracy either in public use or private use allocation. Lastly, I find that only in swing districts there exists a positive correlation between the amount of land allocated and voting behavior in the 1997 elections.

The evidence has unraveled one possible mechanism for the increased deforestation that has been extensively highlighted within and outside Kenya. I investigated a particular institutional

[38] I conduct a similar exercise using districts instead of provinces to tabulate their ethnic composition, this exercise reveals the same.

[39] Results are not reported in the interest of space.

change, the introduction of multi-party elections in a weakly democratic state, to see its effect on an important resource: forests. This institutional change occurred in a state where ethnicity is salient. I show that the introduction of multi-party democracy in this setting seems to have had negative consequences on the environment. Attempts at helping these economies have to take into account the incentives of their leaders and how these are aligned. The setting I study reveals that in the presence of ethnic fragmentation, institutional strength is vital and simply implementing elections may not be enough.[40]

[40]Polity IV data reveals that executive constraint remained constant during the transition to multi-party elections but political competition increased.

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A Data Sources

Satellite Imagery

The core data for this work is constructed from processing raw satellite images from the Landsat Global Survey Mission. Landsat satellite images are the world's longest continuously acquired collection of space based land remote sensing data. Landsat's operations are run by National Oceanic and Atmospheric Administration (NOAA) and the US Geological Survey. The launch of the Landsat in the early 1970's was to observe and study natural and man-made changes on the Earth's surface. Despite the upgrade of satellite technologies the objective has fundamentally been to acquire images on a global basis repetitively and under near identical atmospheric and plant physiological conditions. USGS and NASA (1995) provides technical details on the Landsat Project. Note (i) current remote sensing technology can adequately measure deforestation but is less useful for assessing forest degradation (which requires ground assessment) because degraded forests are a complex mix of different vegetation. Hence, I will not be able to provide evidence of degradation which is an equally important issue (ii) satellite imagery extraction does not allow, me to further break down the category of closed canopy forest. Closed canopy forest in my analysis includes both the indigenous forests and plantation forests. This is not a major concern as 90% of closed canopy forest is indigenous forest and 10% is plantation forest, see Wass (1995) for a discussion. I detail below the steps carried out on each of the 36 useable cloud-free images that I acquired:

1. The raw satellite images contain different spectral bands of the electromagnetic spectrum. The bands suitable for the purpose of forest cover is *green, red and infrared*(IR). When these bands are combined in a particular manner (known as *false color*) the unique nature of the reflectance patterns at different wavelengths allows the researcher to distinguish from vegetation and non-vegetation surfaces.[41] In the case of computer-assisted interpretation of remotely sensed images the spectral response pattern, the color is the only criteria used. Each of the reflected bands has a digital number assigned to it representing the brightness of each area. To create the false color composite image, these bands are *stretched* to enhance the image to allow clear distinction between the various landscapes. Figure 13 displays the individual bands for a particular scene (this is the forest surrounding Mt. Kenya known as the Mt. Kenya Forest Reserve which I will use as an illustration). Each of the bands are stretched to form the false color composite.

2. Before the scene can be analyzed there is a further challenge: the images come in different

[41] This distinction is possible due to the process of photosynthesis within the cell structure of plants, whereby the solar radiation will be converted into energy. The plant's cell structure contains the pigment chlorophyll which absorbs the *blue* and *red* (visible wavelengths) and reflects off *near-infrared* and *green* wavelengths, which is visible to us. Infrared energy penetrates deeper into the leaf structure and is strongly scattered by the cells within the mesophyll.

datums, projection and sometimes pixel size. The datum and projection are all brought to the same system to enable geo-referencing. The final step is to perform *image to image registration*- in other words, all the different images are aligned such that all the pixel grids of the images correspond to the same pixel grids in the previous images. This is made possible by obtaining Survey of Kenya Topography maps.[42] Figure 12 illustrates the required topography maps and figure 14 displays the geo-referencing between topography maps and Landsat images.

3. Once image-to-image registration is completed the next step than is to run *supervised maximum likelihood classification* which allows to identify forest coverage. Briefly, the process is to locate representative of each land cover type (water, forest, urban settlement, lakes etc) called *training sites*. These sites are than run on the images to distinguish different land classes for the whole image. Once that is complete the non-forest area is masked out. The final step is to overlay the constituency boundaries to extract constituency-year level forest coverage. GIS tools are then used to calculate in hectares the amount of forest at the constituency-year level, which forms the main dependent variable of my analysis. The whole process is depicted in Figure 15: (1) displays a false color composite image, (2) the image after supervised maximum likelihood algorithm is completed, (3) forest and non-forest area is identified and finally (4) illustrates only the forest area masked out with constituency boundaries. Note, in order to use supervised maximum likelihood it is essential to know ex-ante the spectral properties of each land class as well be able to identify areas which are forest from other vegetation. In classifying land usage I (i) use the forest reserve boundaries from topography maps which were used to geo-reference from the Survey of Kenya to sense check my initial classification of forest areas. These maps predate my study period (ca. 1965 – 68) and allow me to distinguish forest from other vegetation (ii) Further, as a robustness check on the more modern period, I check my supervised maximum likelihood classification with the Africover Project (2000) and find 93% correlation with my classification.[43]

Government Excision Data

I cross-check my Government excision data with a range of sources to ensure I have the universe of all excisions: (i) I obtain access to several documents in the public domain as well as various confidential reports at the Ministry of Lands in Nairobi to supplement my data e.g. confidential documents such as the memo to the Permanent Secretary of Natural Resources from the Commissioner of Lands; (ii) I am able to obtain access to the District Land Registry Offices to check the

[42] As mentioned previously 275 topography maps cover Kenya's forest reserves - these maps are at the 1:50,000 scale.

[43] Africover Project (2000) was conducted by the UN's FAO. I use the East African Module. The programme's purpose was to build capacity in the region. For Kenya, FAO used the 1995 Landsat images to classify land in its different uses, including a class for closed canopy forest. My archive of images also contains the same set of images thus allowing me compare my methodology with the project.

authenticity of my information; and (iii) in 2004 President Kibaki set up a *Commission on Inquiry into the Irregular and Illegal Allocations of Public* which allows me to supplement my data with all those excisions which did not have a gazette notice put up in the *Kenya Gazette* but in reality took place in the forest land.[44]

Population Census & Voting

Three basic sources of data are obtained: (i) Population Census (1969, 1979, 1989, 1999) from the Central Bureau of Statistics: Nairobi, Kenya; (ii) Electoral Data for the 1992 and 1997 multi-party elections are obtained from the National Election Monitoring Unit, Election Commission of Kenya, Nairobi, Kenya; and (iii) District Boundary Maps (1979, 1979, 1989 and 1999) from the Cartography Archive Department of the Survey of Kenya (SoK).

[44]Note that no additional excisions took place on forest land post-2002 when the regime changed.

B Tables

Table 1: Landsat Satellite Imagery Archive & Number of Constituencies 1979-2002

scene	1986	1987	1989	1991	1995	2000	2001	2002	
P168R58	1	0	0	0	0	1	0	0	
P168R59	1	0	0	0	0	1	1	0	
P168R60	0	17	0	0	18	18	19	19	
P168R61	0	4	0	0	4	4	0	3	
P169R59	3	0	0	0	0	4	0	0	
P169R60	10	0	11	0	14	9	0	0	
P169R61	2	0	0	2	0	2	0	0	
P170R59	3	0	0	0	4	3	4	0	
P170R60	3	0	3	0	3	3	3	0	
P180R59	0	0	0	0	0	0	0	0	
P180R60	0	0	0	0	0	0	0	0	
P180R61	0	0	0	0	0	0	0	0	
P181R59	0	0	0	0	0	0	0	0	
P181R60	0	0	0	0	0	0	0	0	
P181R61	0	0	0	0	0	0	0	0	
P182R59	0	0	0	0	0	0	0	0	
P182R60	0	0	0	0	0	0	0	0	
Total	**23**	**21**	**14**	**2**	**43**	**45**	**27**	**22**	**197**

Note: Each cell contains the number of constituencies I can observe for that scene-year.

Table 3: Political Alignment & Voting of Districts

	(1)	(2)	(3)
Type of District	Opposition	Swing	Loyal
$V_{d,1992}$	0.108	0.450	0.904
	(0.117)	(0.176)	(0.117)
$(Winner - RunnerUp)_{d,1992}$	0.581	0.244	0.842
	(0.306)	(0.143)	(0.197)
# of Districts	9	9	8

NOTE.- Reported are the means and standard deviations in parentheses by type of districts. $V_{d,1992}$ is the share of the votes in district d, that went to ruling party (KANU) in the 1992 elections. $(Winner - RunnerUp)_{d,1992}$ is the difference in vote share of the winning party and the runner-up party in district d in the 1992 elections. Votes are aggregated to the 1988 population census district boundaries. Data sources and construction are described in Data Appendix.

Table 2: Sample Districts
Ethnic Demographics & Politics

Province	District	Politics of District	ETHNIC DEMOGRAPHICS *Kikuyu*	*Embu*	*Meru*	*Luo*	*Luhya*	*Kamba*	*Kalenjin*	*Kisii*	*Coastal*	*Turkana -Samburu*	*Somali*	*Masai*	*Other*
Central	Kiambu	Opposition	94.49%	0.25%	0.16%	0.98%	1.02%	1.42%	0.14%	0.12%	0.10%	0.03%	0.09%	0.07%	1.13%
Central	Kirinyaga	Opposition	96.42%	0.58%	0.47%	0.26%	0.22%	1.63%	0.05%	0.02%	0.06%	0.02%	0.03%	0.01%	0.23%
Central	Murang'a	Opposition	96.19%	0.11%	0.06%	0.26%	0.31%	2.64%	0.05%	0.02%	0.05%	0.02%	0.05%	0.02%	0.23%
Central	Nyandarua	Opposition	94.65%	0.06%	0.18%	0.50%	0.70%	0.51%	2.00%	0.36%	0.06%	0.41%	0.05%	0.16%	0.36%
Central	Nyeri	Opposition	97.76%	0.08%	0.24%	0.23%	0.23%	0.29%	0.13%	0.04%	0.12%	0.11%	0.08%	0.05%	0.64%
Eastern	Embu	Opposition	3.93%	87.12%	1.39%	0.12%	0.17%	6.74%	0.06%	0.03%	0.06%	0.03%	0.07%	0.00%	0.27%
Eastern	Meru	Opposition	1.39%	0.33%	97.35%	0.05%	0.06%	0.34%	0.04%	0.02%	0.02%	0.09%	0.06%	0.01%	0.25%
Rift Valley	Laikipia	Opposition	57.47%	0.26%	3.10%	1.21%	1.36%	1.26%	11.14%	0.40%	0.19%	18.72%	0.97%	1.69%	2.23%
Western	Bungoma	Opposition	1.75%	0.01%	0.01%	0.39%	83.52%	0.09%	9.49%	0.06%	0.03%	4.02%	0.06%	0.17%	0.40%
Eastern	Kitui	Swing	0.20%	0.07%	1.80%	0.05%	0.06%	97.33%	0.02%	0.02%	0.15%	0.02%	0.03%	0.01%	0.25%
Eastern	Machakos	Swing	1.10%	0.04%	0.04%	0.32%	0.21%	97.65%	0.04%	0.04%	0.14%	0.04%	0.07%	0.02%	0.29%
Nairobi	Nairobi	Swing	37.58%	0.68%	0.83%	12.34%	12.77%	11.92%	1.07%	0.77%	1.17%	0.23%	0.50%	0.19%	19.94%
Rift Valley	Nakuru	Swing	58.23%	0.11%	0.26%	7.08%	8.30%	1.78%	12.84%	1.39%	0.26%	5.04%	0.33%	1.34%	3.03%
Rift Valley	Trans Nzoia	Swing	14.17%	0.01%	0.07%	3.23%	47.12%	0.64%	19.45%	0.41%	0.05%	9.24%	0.16%	1.13%	4.32%
Rift Valley	Uasin Gishu	Swing	21.74%	0.04%	0.10%	2.78%	15.05%	0.45%	53.17%	0.41%	0.11%	2.37%	0.30%	0.62%	2.86%
Rift Valley	Kajiado	Swing	18.93%	0.04%	0.16%	1.88%	1.36%	5.03%	0.43%	0.25%	0.17%	0.13%	0.50%	68.64%	2.49%
Western	Busia	Swing	0.14%	0.00%	0.00%	2.66%	65.13%	0.05%	0.24%	0.18%	0.02%	30.86%	0.01%	0.33%	0.38%
Western	Kakamega	Swing	0.59%	0.01%	0.04%	1.72%	95.65%	0.05%	1.25%	0.08%	0.03%	0.20%	0.02%	0.06%	0.29%
Eastern	Marsabit	Loyal	0.39%	0.03%	0.43%	0.11%	0.09%	0.23%	0.10%	0.03%	0.06%	38.06%	58.93%	0.03%	1.51%
Rift Valley	Baringo	Loyal	7.49%	0.02%	0.01%	0.52%	0.49%	0.08%	85.10%	0.25%	1.04%	4.32%	0.24%	0.06%	0.37%
Rift Valley	Elgeyo Marakwet	Loyal	1.82%	0.01%	0.01%	0.10%	0.56%	0.06%	96.52%	0.10%	0.05%	0.49%	0.04%	0.09%	0.15%
Rift Valley	Kericho	Loyal	5.53%	0.01%	0.02%	5.61%	1.59%	0.21%	81.74%	4.27%	0.04%	0.13%	0.03%	0.01%	0.82%
Rift Valley	Nandi	Loyal	4.47%	0.01%	0.01%	3.58%	11.34%	0.07%	78.09%	1.23%	0.12%	0.37%	0.10%	0.01%	0.58%
Rift Valley	Narok	Loyal	3.66%	0.01%	0.06%	0.67%	0.54%	0.15%	25.75%	0.99%	0.06%	0.97%	0.18%	66.48%	0.47%
Rift Valley	Samburu	Loyal	2.07%	0.02%	0.25%	0.28%	0.23%	0.16%	0.79%	0.11%	0.12%	94.49%	0.85%	0.13%	0.49%
Rift Valley	West Pokot	Loyal	1.67%	0.01%	0.02%	0.30%	1.60%	0.07%	93.37%	0.14%	0.03%	2.10%	0.07%	0.12%	0.50%

NOTE.- Authors calculations and Kenya Population Census 1989.

Table 4: Satellite Imagery 1979-2002
Forest Size & Introduction of Democracy

Dependent variable: **Size of Forest, Log Sqr Km. [c,t]**					
	(1)	(2)	(3)	(4)	(5)
Post-1992 dummy=1	-0.211**	-0.212***	0.024	0.035	0.346***
	(0.086)	(0.027)	(0.033)	(0.047)	(0.121)
Population, log [d,t]			-0.799***	-0.744***	-0.848***
			(0.119)	(0.141)	(0.133)
[1979-2002] trend				-0.002	0.027***
				(0.005)	(0.009)
Post-1992 dummy=1*[1979-2002] trend					-0.030***
					(0.010)
Constant	4.988***	4.989***	15.515***	14.807***	15.908***
	(0.111)	(0.019)	(1.566)	(1.824)	(1.715)
R-squared	0.011	0.987	0.991	0.991	0.992
Observations	197	197	197	197	197
Constituency fixed effects [48]	✗	✓	✓	✓	✓
Implied effect at 1993					-0.099**
					(0.047)
Implied effect at 1997					-0.218**
					(0.077)
Implied effect at 2002					-0.367***
					(0.120)

NOTE.- OLS regressions on an *unbalanced* panel of constituency-year containing 48 constituencies across the years 1979-2002. Post-1992 is dummy variable whose value is one in all years greater than 1992. Implied effects are simply the trends post-1992 calculated at various years using the delta method. Standard errors corrected for clustering at the district level [22] are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. Data sources and construction are described in Data Appendix.

Table 5: Satellite Imagery 1979-2002
Forest Size & Politics

Dependent variable: **Size of Forest, Log Sqr Km. [c,t]**						
	(1)	(2)	(3)	(4)	(5)	(6)
Post-1992 dummy =1	0.346***	0.011	0.530*	0.758***	0.164	0.084
	(0.121)	(0.210)	(0.235)	(0.181)	(0.284)	0.194
Population, log [d,t]	-0.848***	-0.255	-0.762	-0.890***	-0.835***	-0.844***
	(0.133)	(0.561)	(0.871)	(0.106)	(0.130)	(0.109)
[1979-2002] trend	0.027***	-0.007	0.030	0.070***	0.016	0.016
	(0.009)	(0.022)	(0.037)	(0.015)	(0.012)	(0.012)
Post-1992 dummy=1*[1979-2002] trend	-0.030***	-0.005	-0.042*	-0.074***	-0.012	-0.012
	(0.010)	(0.016)	(0.019)	(0.017)	(0.013)	(0.013)
Swing dummy*[1972-2007] trend					0.018	
					(0.016)	
Loyal dummy*[1972-2007] trend					0.053**	0.053**
					(0.020)	(0.020)
Swing dummy*Post-1992 dummy=1					-0.032	
*[1972-2007] trend					(0.021)	
Loyal dummy*Post-1992 dummy=1					-0.062***	-0.062***
*[1972-2007] trend					(0.021)	(0.021)
Swing dummy*Post-1992 dummy=1					0.688	
					(0.422)	
Loyal dummy*Post-1992 dummy=1					1.105**	0.671**
					(0.403)	(0.264)
Constant	15.908***	8.234	14.879	16.244***	15.191***	15.191***
	(1.715)	(6.983)	(11.313)	(1.508)	(1.728)	(1.453)
R-squared	0.992	0.996	0.993	0.987	0.992	0.988
Observations	197	110	33	54	197	164
Constituency fixed effects [48]	✓	✓	✓	✓	✓	✓
Sample districts [#]	All [22]	Opposition [9]	Swing [5]	Loyal [8]	All [22]	Loyal & Opp [17]
Implied effect at 1993	-0.099**	-0.057	-0.102	-0.346***		
	(0.047)	(0.078)	(0.058)	(0.101)		
Implied effect at 1997	-0.218**	-0.075	-0.271*	-0.640***		
	(0.077)	(0.119)	(0.130)	(0.161)		
Implied effect at 2002	-0.367***	-0.098	-0.481*	-1.008***		
	(0.120)	(0.188)	(0.225)	(0.241)		

NOTE.- OLS regressions on an *unbalanced* panel of constituency-year containing 48 constituencies across the years 1979-2002. Post-1992 is as defined in the previous table. Implied effects are the trends post-1992 calculated at various years using the delta method. Standard errors corrected for clustering at the district level [22] are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. Data sources and construction are described in the Appendix.

Table 6: Excisions 1979-2002
Descriptives: All Districts
FOREST EXCISIONS (HA. LOG)
by pre- and post-1992 to type of excisions

Sample	All Excisions (1)	Public Use Excision (2)	Private Use Excision (3)
Post-1992 dummy =0	0.681	0.258	0.441
	(1.822)	(1.029)	(1.560)
N	364		
Post-1992 dummy =1	1.309	0.485	1.010
	(2.479)	(1.327)	(2.341)
N	260		
Difference	0.628***	0.226*	0.569***
	(0.195)	(0.162)	(0.166)
N	624		

NOTE.- Means and standard errors are reported in parentheses. Summary statistics on a *balanced* panel data set of 26 districts across 24 years (1979-2002). Post-1992 is dummy variable whose value is one in all years greater than 1992. Sample: column (1) is simply all the excisions; column (2) is excision of forest land for the purpose of the public e.g. school building, churches etc and column (3) is excision of forest land for the purpose of individual allotment or settlement land for squatters. The standard errors on the simple differences are estimated from running the corresponding least squares regression, allowing the standard errors to be clustered by district [26] are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. Data sources and construction are described in the Appendix.

Table 7: Excisions 1979-2002
Democracy & Type of Excision Allocated

Dependent variable: **Size of Excisions, Ha Log [d,t]**						
Sample	All Excisions				Public Use Excisions	Private Use Excisions
	(1)	(2)	(3)	(4)	(5)	(6)
Post-1992 dummy	0.628***	0.628***	0.574**	0.734**	0.289	0.626***
	(0.195)	(0.199)	(0.260)	(0.264)	(0.182)	(0.217)
Population, log [d,t]			0.146	1.256	-0.763	2.552*
			(0.350)	(1.371)	(0.740)	(1.365)
[1979-2002] trend				-0.048	0.018	-0.084*
				(0.049)	(0.026)	(0.047)
Constant	0.681***	0.681***	-1.213	-15.214	9.994	-31.942*
	(0.148)	(0.083)	(4.510)	(17.372)	(9.391)	(17.327)
R-squared	0.021	0.169	0.169	0.171	0.098	0.107
Observations	624	624	624	624	624	624
District fixed effects [21]	✗	✓	✓	✓	✓	✓

NOTE.- OLS regressions on an *balanced* panel dataset of 26 districts across 24 years (1979-2002). Post-1992 is dummy variable whose value is one in all years greater than 1992. The different samples (All Excisions, Public Use Excisions, Private Use Excisions) are as defined in the previous table. Data sources and construction are described in the Appendix. Standard errors corrected for clustering at the district level are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Excisions & Politics 1979-2002
Descriptives: Type of District
FOREST EXCISIONS (HA. LOG)
by pre- and post-1992 to type of excisions

	All Excisions (1)	Public Use Excisions (2)	Private Use Excisions (3)
Panel A: Opposition Districts			
Post-1992 dummy =0	0.563	0.239	0.329
	(1.634)	(0.974)	(1.348)
Post-1992 dummy =1	1.242	0.346	0.908
	(2.403)	(1.117)	(2.267)
Difference	0.679	0.107	0.577
	(0.378)	(0.209)	(0.310)
Panel B: Swing Districts			
Post-1992 dummy =0	0.633	0.388	0.254
	(1.584)	(1.319)	(0.883)
Post-1992 dummy =1	1.155	0.415	0.936
	(2.348)	(1.147)	(2.258)
Difference	0.522	0.027	0.682**
	(0.294)	(0.191)	(0.278)
Panel C: Loyal Districts			
Post-1992 dummy =0	0.868	0.134	0.775
	(2.230)	(0.634)	(2.205)
Post-1992 dummy =1	1.558	0.719	1.207
	(2.708)	(1.674)	(2.525)
Difference	0.690	0.584*	0.432
	(0.380)	(0.256)	(0.324)

NOTE.- Means and standard errors are reported in parentheses. Summary statistics on a *balanced* panel data set of 26 districts across 24 years (1979-2002). Post-1992 is dummy variable whose value is one in all years greater than 1992. Sample: column (1) is simply all the excisions; column (2) is excision of forest land for the purpose of the public e.g. school building, churches etc and column (3) is excision of forest land for the purpose of individual allotment or settlement land for squatters. Number of observations in Panel A [216], Panel B [216] and Panel C [192]. The standard errors on the simple differences are estimated from running the corresponding least squares regression, allowing the standard errors to be clustered by district [Panel A: 9, Panel B: 9 and Panel C: 8] are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. Data sources and construction are described in the Appendix.

Table 9: Excisions & Elections 1993-1997
Vote Buying?

Dependent variable: $\Delta\ Votes_{97-92,d}$					
	(1)	(2)	(3)	(4)	(5)
$S_{1993-97,d}$	0.004	-0.008	0.025***	-0.005	-0.008
	(0.006)	(0.007)	(0.004)	(0.014)	(0.007)
Swing dummy					-0.174***
					(0.034)
Loyal dummy					-0.036
					(0.108)
Swing dummy*$S_{1993-97,d}$					0.032***
					(0.009)
Loyal dummy*$S_{1993-97,d}$					0.003
					(0.016)
Constant	-0.010	0.058**	-0.116***	0.023	0.058**
	(0.037)	(0.023)	(0.026)	(0.107)	(0.023)
R-squared	0.023	0.127	0.841	0.025	0.364
# of Districts	26	9	9	8	26
Sample districts	All	Opposition	Swing	Loyal	All

NOTE.- OLS regressions on a cross-section of districts. The dependent variable, $\Delta\ Votes_{97-92,d}$ is the difference in votes to the ruling party, (KANU) between the 1992 and 1997 multi-party elections aggregated at the 1988 district level boundaries. $S_{1993-97,d}$ is the cumulative area (logs) in excisions between the two elections (1993-1997) allocated to district d. Standard errors corrected for clustering at the district level are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. Data sources and construction are described in the Appendix.

C Appendix Tables

Table 10: Appendix Table - Provincial Ethnic Shares: 1962-1989

Panel A: 1969 Census

	Kikuyu	**Luo**	**Luhya**	**Kamba**	**Kalenjin**
Central	**73.00%**	0.53%	0.60%	2.00%	0.42%
Coast	0.88%	2.05%	1.34%	4.83%	0.17%
Eastern	1.12%	0.21%	0.17%	**86.73%**	0.07%
Nairobi	8.69%	4.13%	4.48%	5.07%	0.46%
North-Eastern	0.03%	0.02%	0.02%	0.04%	0.02%
Nyanza	0.27%	**87.20%**	2.81%	0.10%	0.52%
Rift Valley	15.51%	4.54%	10.25%	1.15%	**94.72%**
Western	0.50%	1.33%	**80.33%**	0.07%	3.62%

Panel B: 1979 Census

	Kikuyu	**Luo**	**Luhya**	**Kamba**	**Kalenjin**
Central	**69.19%**	0.92%	1.11%	2.32%	0.30%
Coast	1.22%	3.00%	1.70%	5.16%	0.15%
Eastern	1.34%	0.37%	0.26%	**84.85%**	0.07%
Nairobi	8.64%	7.46%	6.33%	5.98%	0.58%
North-Eastern	0.06%	0.06%	0.04%	0.11%	0.02%
Nyanza	0.21%	**79.66%**	2.86%	0.13%	0.29%
Rift Valley	18.77%	6.08%	13.98%	1.35%	**94.85%**
Western	0.59%	2.45%	**73.71%**	0.10%	3.76%

Panel B: 1989 Census

	Kikuyu	**Luo**	**Luhya**	**Kamba**	**Kalenjin**
Central	**65.55%**	1.00%	1.25%	2.28%	0.30%
Coast	1.31%	3.04%	1.80%	5.19%	0.18%
Eastern	1.33%	0.30%	0.22%	**83.01%**	0.09%
Nairobi	9.63%	8.91%	7.07%	7.30%	0.89%
North-Eastern	0.06%	0.06%	0.04%	0.11%	0.03%
Nyanza	0.19%	**77.31%**	2.95%	0.14%	0.27%
Rift Valley	21.43%	7.01%	15.55%	1.86%	**94.89%**
Western	0.51%	2.37%	**71.12%**	0.12%	3.35%

NOTE.- Provincial shares of ethnic groups are calculated by taking the total population of a particular ethnic group in a province divided by the total national population of that ethnic group. Provincial boundaries have *not* changed since independence (1963). Source: Author's calculations and Kenya Population Census 1969-1989.

Table 13: Appendix Table - Land Tenure & Management of Closed Canopy Forest

Category of Gazettement	**Land Tenure** [***Management***]	**% Closed Canopy Forest Cover (approx)**
Forest Reserves	Government Land [*Forest Department*]	85%
Nature Reserves	Government Land [*Forest Department*]	2%
National Parks	Government Land [*Kenya Wildlife Service*]	4%
National & Marine Reserves	Government Land [*Kenya Wildlife Service*]	1%
Sanctuary	Trust Lands [*County Council*]	< 1%
Trust Land	Trust Land [*County Council*]	7%
National Monument	Govt/Trust Land/Private [*National Museums of Kenya*]	< 1%
Private Ownership	Private [*Private*]	< 1%

NOTE.- All Nature Reserves occur in Forest Reserve. Forest Reserves also contains 5% of Mangroves (Coastal forests) and 1% Riverine forests. Private ownership holdings tends to be small and no official documentation exists at the Ministry of Land & Settlement or the Forest Department. Sources: Author's calculations using reports from Forestry Department-Survey Section, Kenya Indigenous Forest Conservation Programme (KIFCON) and Kenya Wildlife Service (KWS).

Table 11: Appendix Table - National Ethnic Shares: 1962-1989

Census	Kikuyu	Embu	Meru	Luo	Luhya	Kamba	Kalenjin	Kisii	Coastal	Turkana-Samburu	Somali	Masai	Total populatio
1962	19.10%	1.50%	5.50%	13.30%	12.60%	10.80%	10.50%	6.70%	6.60%	4.00%	4.10%	1.80%	8,636,263
1969	20.10%	1.60%	5.60%	13.90%	13.30%	10.90%	10.90%	6.90%	6.50%	3.70%	2.80%	1.40%	10,956,50
1979†	20.90%	1.58%	5.55%	12.76%	13.83%	11.26%	10.78%	6.74%	6.39%	2.94%	3.37%	1.57%	15,327,06
1989	20.78%	1.67%	5.53%	12.38%	14.38%	11.42%	11.46%	6.67%	6.86%	2.72%	2.92%	1.76%	21,448,77

NOTE.- The Embu ethnic group includes the Embu and Mbeere tribes; the Meru ethnic group includes the Meru and Tharaka tribes; the Luo eth group includes the Luo and Basuba tribes; the Kisii ethnic group includes the Kisii and the Kuria tribes; the Coastal ethnic group are the Mijiken Pokomo/Riverine, Taveta, Taita, Swahili/Shirazi, Bajunand and Boni/Sanye tribes. The Turkana-Samburu category includes the Samburu, Turka Teso, Nderobo, Njemps, Rendille and the El Molo tribes. The Somali group includes the Boran, Gabbra, Sakuye, Orma, Gosha, Ogaden, Ajur Gurreh and Other Somalis. † The ethnic group Kalenjin replaced the six sub-tribes of the Kalenjin for the first time when the 1979 Population Cen was published. These six subtribes were the Nandi, Kipsigis, Elgeyo, Marakwet, Pokot, Sabaot and Tugen tribes. Source: Author's calculations a Kenya Population Census 1962-1989.

Table 12: Appendix Table - Provincial Voting Patterns 1992
Presidential Elections

Province Leader-[Party]	Western `Luhya`	Nyanza `Luo`	Rift Valley `Kalenjin`	Eastern `Kamba`	Central `Kikuyu`	Nairobi `-`	North Eastern `Somali`	Coast `Mijikenda`	NATIONAL
Moi-[KANU] `Kalenjin`	39.70%	14.32%	67.98%	37.77%	2.19%	16.75%	78.46%	64.31%	**36.66%**
Matiba-[FORD-A] `Kikuyu`	38.84%	3.44%	18.72%	10.81%	62.15%	44.17%	11.00%	8.33%	**26.51%**
Odinga-[FORD-K] `Luo`	18.33 %	75.67%	5.73%	1.64%	1.17%	20.37%	7.64%	16.61%	**17.63%**
Kibaki-[DP] `Kikuyu`	3.13%	6.58%	7.56%	49.79%	34.49%	18.71%	2.90%	10.75%	**19.20%**

NOTE.- Provincial voting patterns in the presidential elections of 1992. `Ethnic Group` denotes ethnic group. Data sources in Appendix.

Table 14: Appendix Table - Landsat Satellite Imagery Archive

Scene (Path, Row)	LANDSAT		Image Date	Projection		Datum (Earth Ellipsoid)	Pixel Size	Archive Source
	Satellite	Instrument		Map Projection	UTM USGS Map Zone			
1986-1988								
P168R58	Landsat-5	TM	May 1986	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R59	Landsat-5	TM	May 1986	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R60	Landsat-5	TM	Feb 1987	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R61	Landsat-5	TM	Feb 1987	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R61	Landsat-4	TM	Oct 1988	SOM		International 1909	28.5 m	RCMRD
P169R59	Landsat-5	TM	Jan 1986	UTM	37 N	WGS 84	28.5 m	RCMRD
P169R60	Landsat-5	TM	Jan 1986	UTM	36 N	WGS 84	28.5 m	RCMRD
P169R61	Landsat-5	TM	Jan 1986	UTM	36 N	WGS 84	28.5 m	RCMRD
P170R59	Landsat-5	TM	Feb 1986	UTM	36 N	WGS 84	30 m	RCMRD
P170R60	Landsat-5	TM	Mar 1986	UTM	36 N	WGS 84	28.5 m	RCMRD
1989-1991								
P169R60	Landsat-4	TM	Mar 1989	SOM		International 1909	28.5 m	UNEP
P169R61	Landsat-5	TM	Mar 1991	SOM		International 1909	28.5 m	UNEP
P170R60	Landsat-4	TM	Nov 1989	SOM		International 1909	28.5 m	RCMRD
1995								
P168R60	Landsat-5	TM	Mar 1995	UTM	37 S	WGS 84	28.5 m	UNEP
P168R61	Landsat-5	TM	Jan 1995	SOM		International 1909	30 m	RCMRD
P169R60	Landsat-5	TM	Feb 1995	UTM	37 N	WGS 84	28.5 m	GLCF
P169R61	Landsat-5	TM	Feb 1995	UTM	36 S	WGS 84	28.5 m	GLCF
P170R59	Landsat-5	TM	Jan 1995	UTM	36 N	WGS 84	30 m	RCMRD
P170R60	Landsat-5	TM	Apr 1995	UTM	36 S	WGS 84	28.5 m	RCMRD
2000								
P168R58	Landsat-7	ETM+	Feb 2000	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R59	Landsat-7	ETM+	Feb 2000	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R60	Landsat-7	ETM+	Feb 2000	UTM	37 N	WGS 84	28.5 m	RCMRD
P168R61	Landsat-7	ETM+	Feb 2000	UTM	37 N	WGS 84	28.5 m	RCMRD
P169R59	Landsat-7	ETM+	Jan 2000	UTM	37 N	WGS 84	28.5 m	RCMRD
P169R60	Landsat-7	ETM+	Jan 2000	UTM	36 N	WGS 84	28.5 m	RCMRD
P169R60	Landsat-7	ETM+	Feb 2000	UTM	36 N	WGS 84	30 m	RCMRD
P169R61	Landsat-7	ETM+	Jan 2000	UTM	36 N	WGS 84	28.5 m	RCMRD
P169R61	Landsat-7	ETM+	Feb 2000	UTM	36 S	WGS 84	30 m	RCMRD
P170R59	Landsat-7	ETM+	Mar 2000	UTM	36 N	WGS 84	28.5 m	RCMRD
P170R60	Landsat-7	ETM+	Mar 2000	UTM	36 N	WGS 84	30 m	GLCF
2001								
P168R59	Landsat-7	ETM+	Mar 2001	ALBERS		WGS 84	30 m	RCMRD
P168R60	Landsat-7	ETM+	Mar 2001	ALBERS		WGS 84	30 m	RCMRD
P168R60	Landsat-7	ETM+	Oct 2002	UTM	37 S	WGS 84	30 m	RCMRD
P168R61	Landsat-7	ETM+	Feb 2002	UTM	37 S	WGS 84	28.5 m	RCMRD
P170R59	Landsat-7	ETM+	Feb 2001	UTM	36 N	WGS 84	28.5 m	RCMRD
P170R60	Landsat-7	ETM+	Feb 2001	UTM	36 N	WGS 84	28.5 m	RCMRD

Note on acronyms:

Universal Transverse Mercator (UTM)

Space Oblique Mercator Projection (SOM)

Word Geodetic System (WGS)

Regional Centre for Mapping of Resources for Development (RCMRD)

United Nations Environmental Programme (UNEP)

Global Land Cover Facility (GLCF)

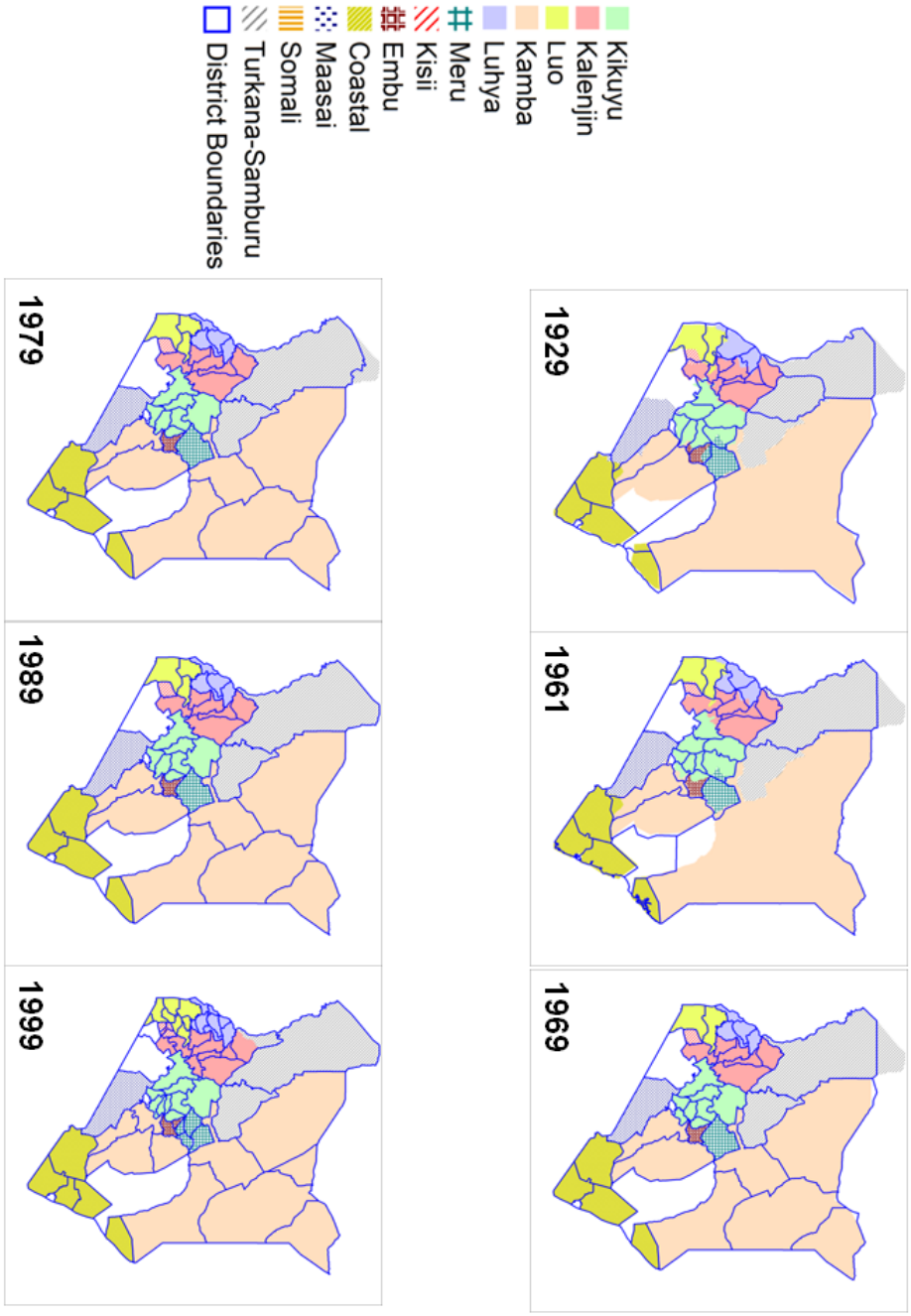
Table 15: Appendix Table - Sample Districts
Satellite Imagery & Excision Data

Province	District	Politics of District	Data Source	
			Satellite Imagery	*Excision Data*
Central	Kiambu	Opposition	✓	✓
Central	Kirinyaga	Opposition	✓	✓
Central	Murang'a	Opposition	✓	✓
Central	Nyandarua	Opposition	✓	✓
Central	Nyeri	Opposition	✓	✓
Eastern	Embu	Opposition	✓	✓
Eastern	Meru	Opposition	✓	✓
Rift Valley	Laikipia	Opposition	✓	✓
Western	Bungoma	Opposition	✓	✓
Eastern	Kitui	Swing	✓	✓
Eastern	Machakos	Swing	✘	✓
Nairobi	Nairobi	Swing	✘	✓
Rift Valley	Nakuru	Swing	✓	✓
Rift Valley	Trans Nzoia	Swing	✓	✓
Rift Valley	Uasin Gishu	Swing	✓	✓
Rift Valley	Kajiado	Swing	✘	✓
Western	Kakamega	Swing	✓	✓
Western	Busia	Swing	✘	✓
Eastern	Marsabit	Loyal	✓	✓
Rift Valley	Baringo	Loyal	✓	✓
Rift Valley	Elgeyo Marakwet	Loyal	✓	✓
Rift Valley	Kericho	Loyal	✓	✓
Rift Valley	Nandi	Loyal	✓	✓
Rift Valley	Narok	Loyal	✓	✓
Rift Valley	Samburu	Loyal	✓	✓
Rift Valley	West Pokot	Loyal	✓	✓

NOTE.- ✓ and ✘ denotes whether the district is observed or not in the respective data set.

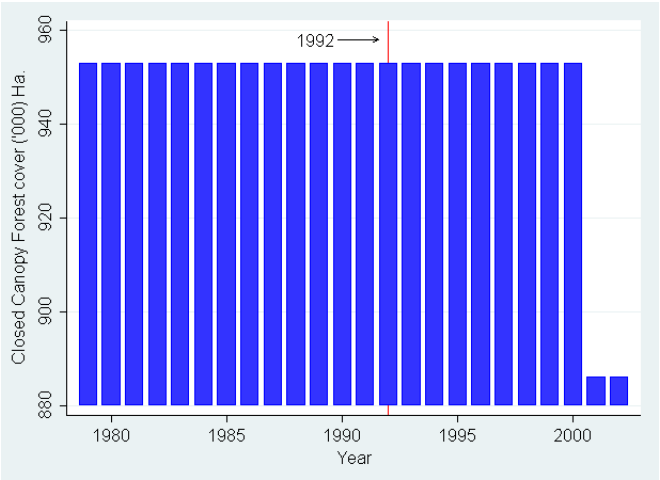
D Figures

Figure 1: Ethnicity & District Evolution 1929-1999



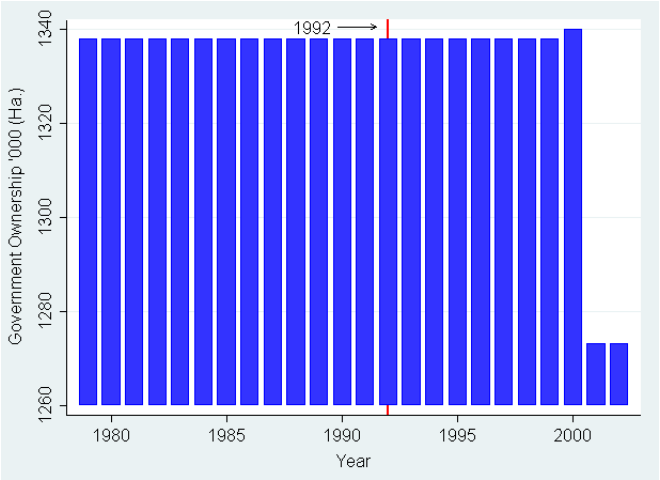
Note.- District boundary changes overlayed on District Ethnic Demographics from the 1989 Population Census. Colored districts reflect an ethnic group containing more than 50% of the district's population. White space denotes districts with no ethnic group being more than 50%.
Source.- See Data Appendix.

Figure 2: Annual Coverage of Closed Canopy Forest



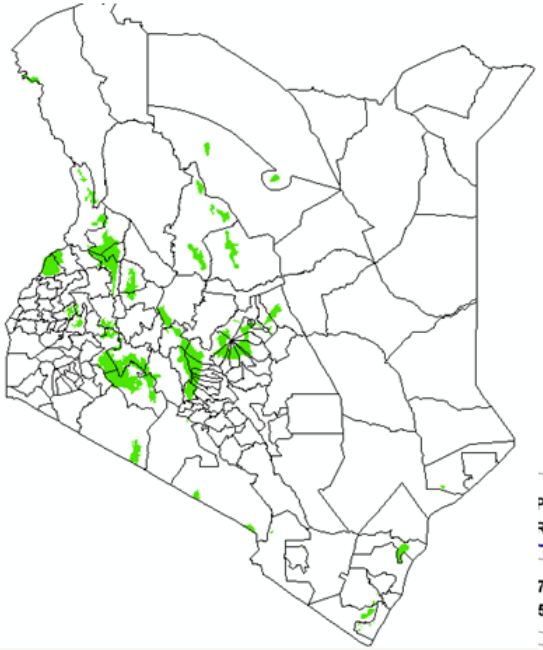
Note.- Total stock of closed canopy forest coverage in Kenya. Source.- Statistical Abstracts 1979-2002, Government of Kenya.

Figure 3: Total Size of ALL forests under Government of Kenya Ownership

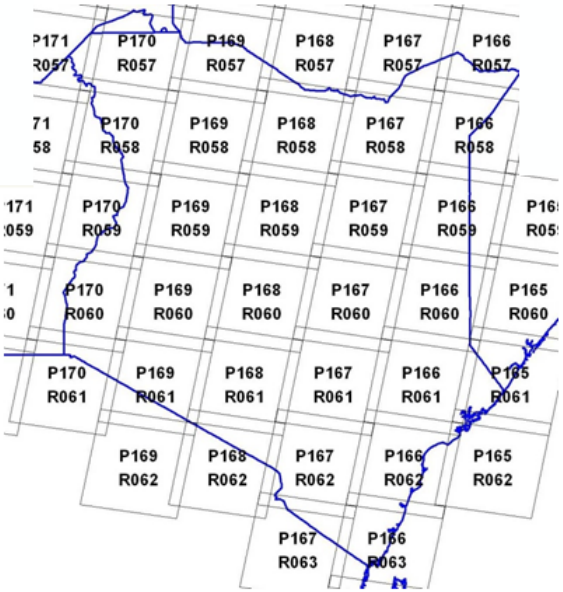


Note.- Total stock of ALL types of forest (this includes Closed Canopy, Woodlands, Bamboo, Grasslands and Coastal Mangroves). Source.- Statistical Abstracts 1979-2002, Government of Kenya.

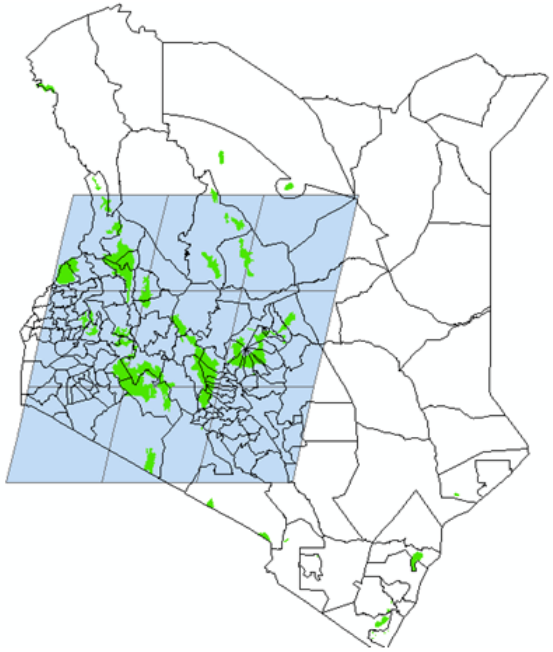
Figure 4: Spatial Distribution of Closed Canopy Forest & Satellite Imagery



[A.] Closed Canopy Forest and Administrative Boundaries.



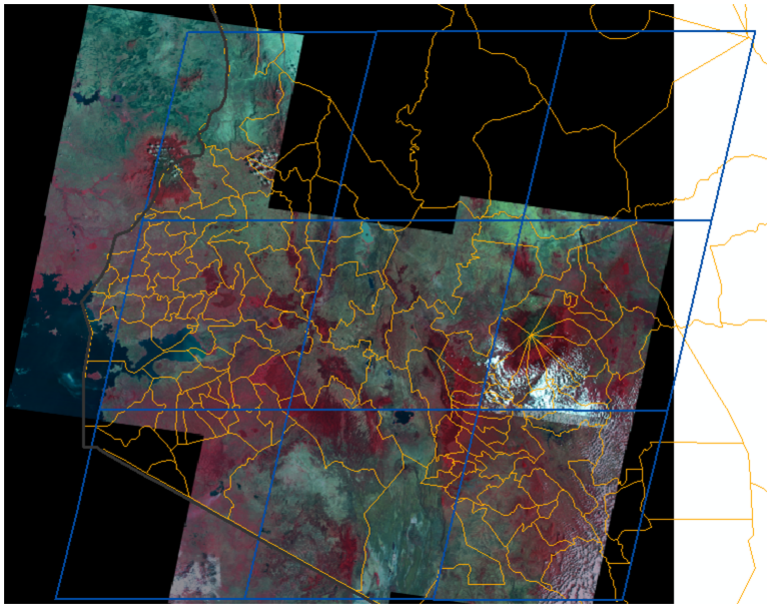
[B]World Reference System for Kenya



[C.] Scenes Required

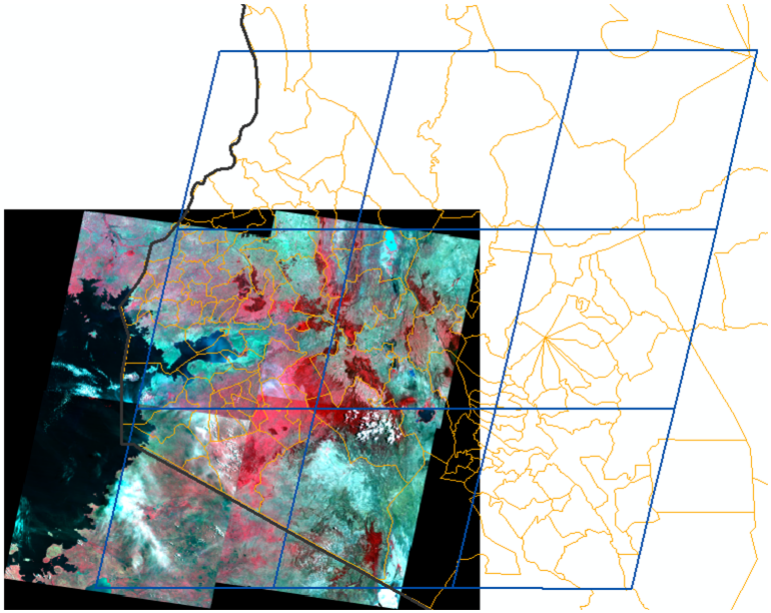
Figure 5: False Color Composites

1995



2

1989 -1991



1

Figure 6: Illustration of Deforestation in Mt. Kenya Forest Reserve

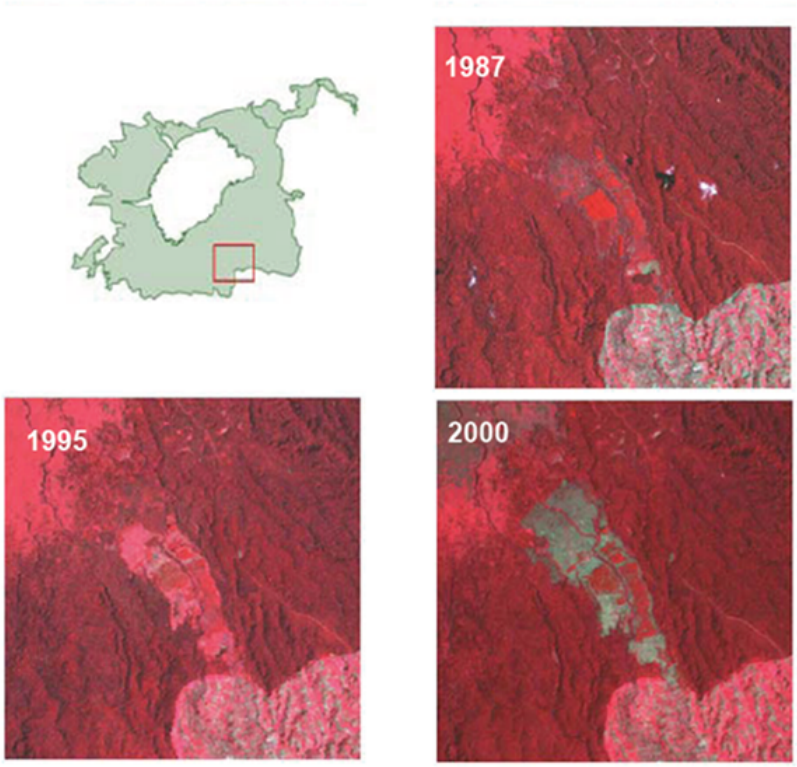
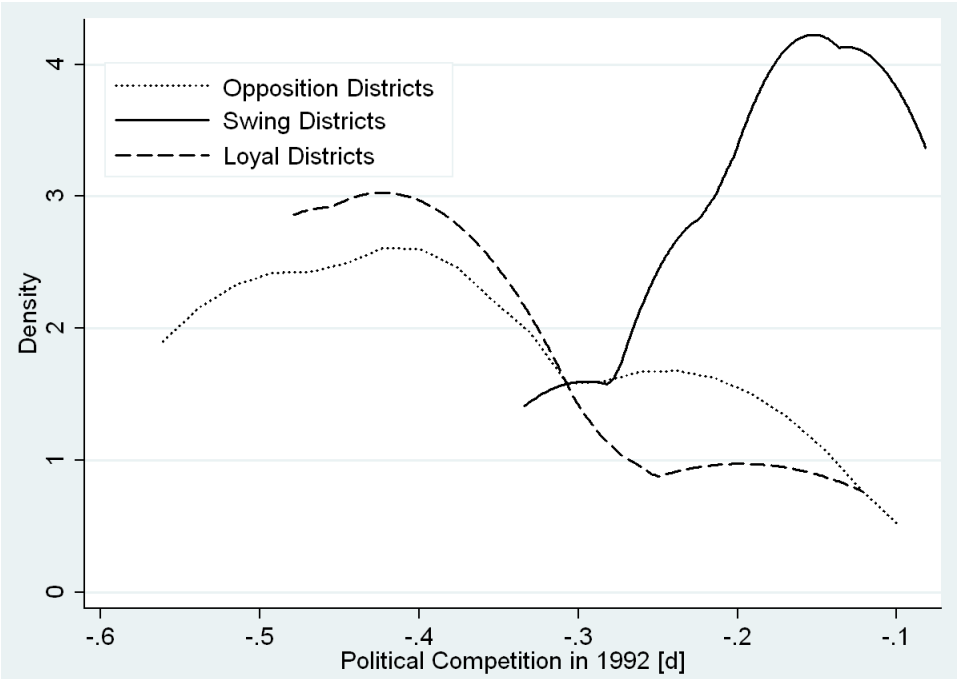


Figure 7: Political Competition by Political Alignment of District.



Political competition is measured as $p_{d,1992} = -|V_{d,1992} - 0.5|$ where $V_{d,1992}$ denotes vote share of KANU for a district d secured in the 1992 multi-party elections. Due to the negative sign, higher values of $p_{d,1992}$ denote more political competition.

Figure 8: 1979-2002: Number of Excisions Per Year

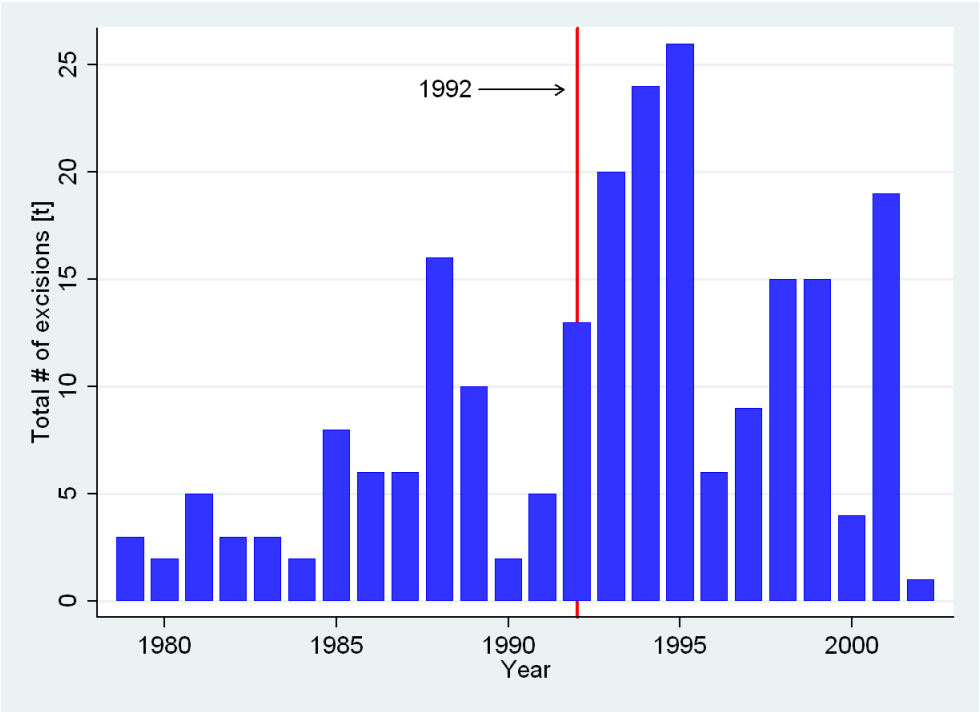


Figure 9: 1979-2002: Total Size of Excisions Per Year

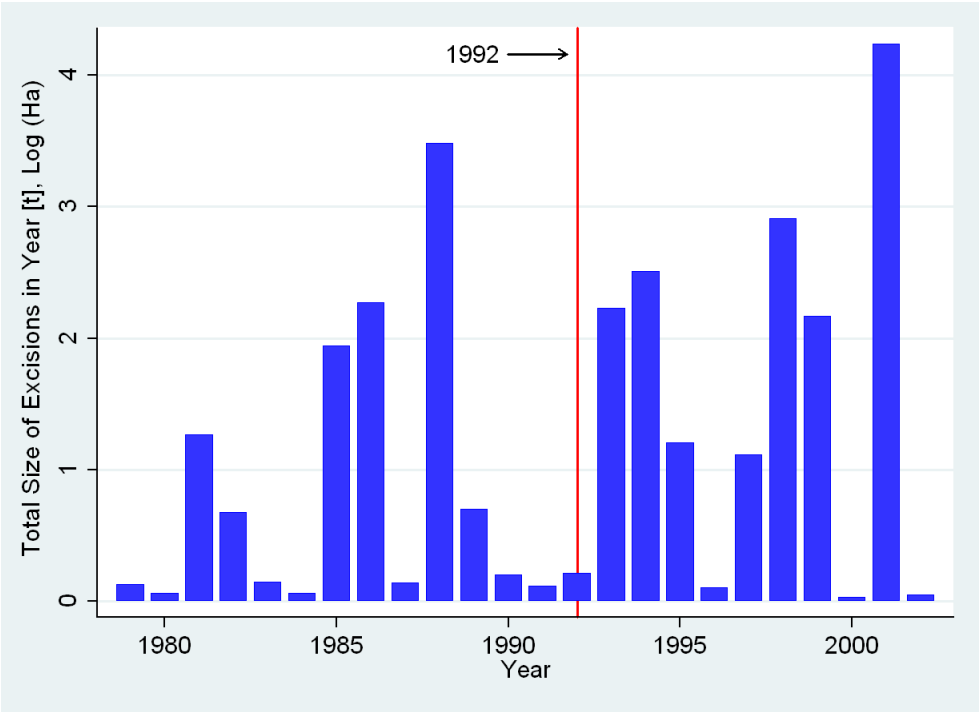


Figure 10: Size of Excision & Introduction of Democracy

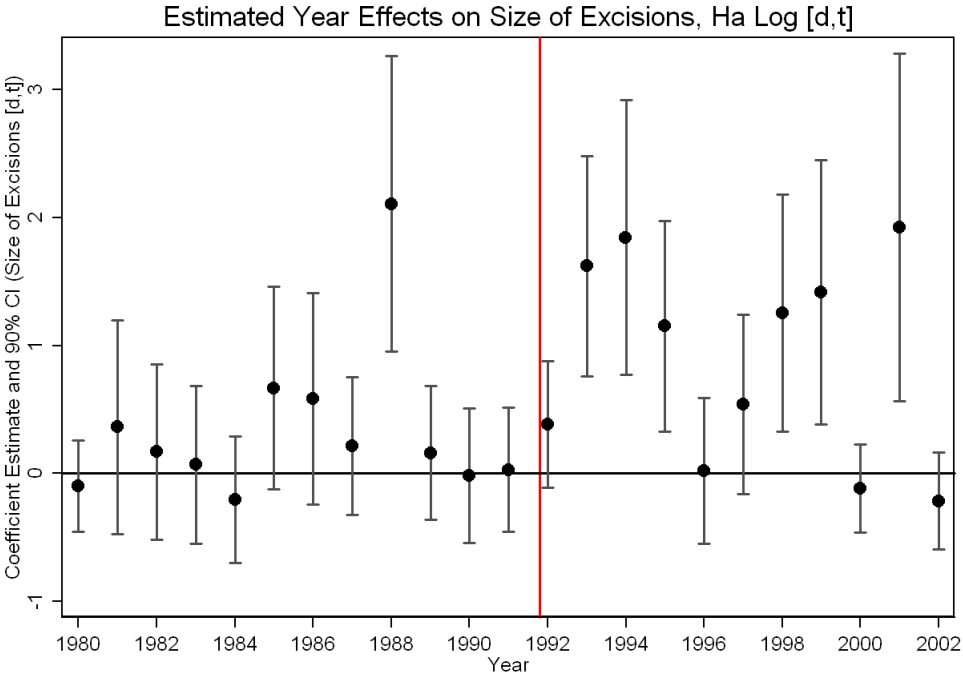


Figure 11: Number of Excisions & Introduction of Democracy

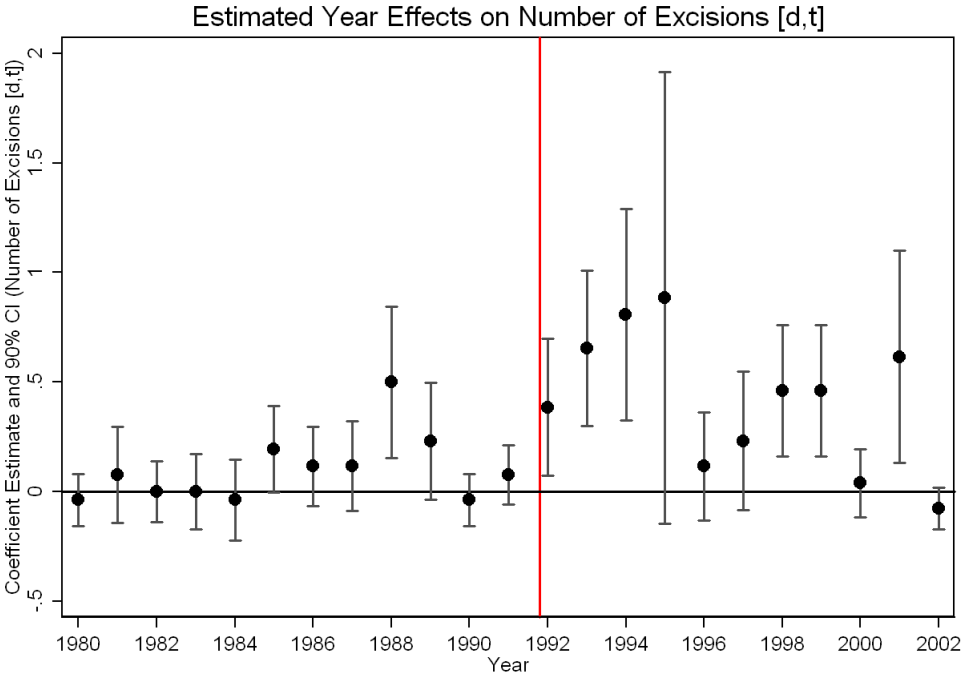


Figure 12: Required Topography Maps

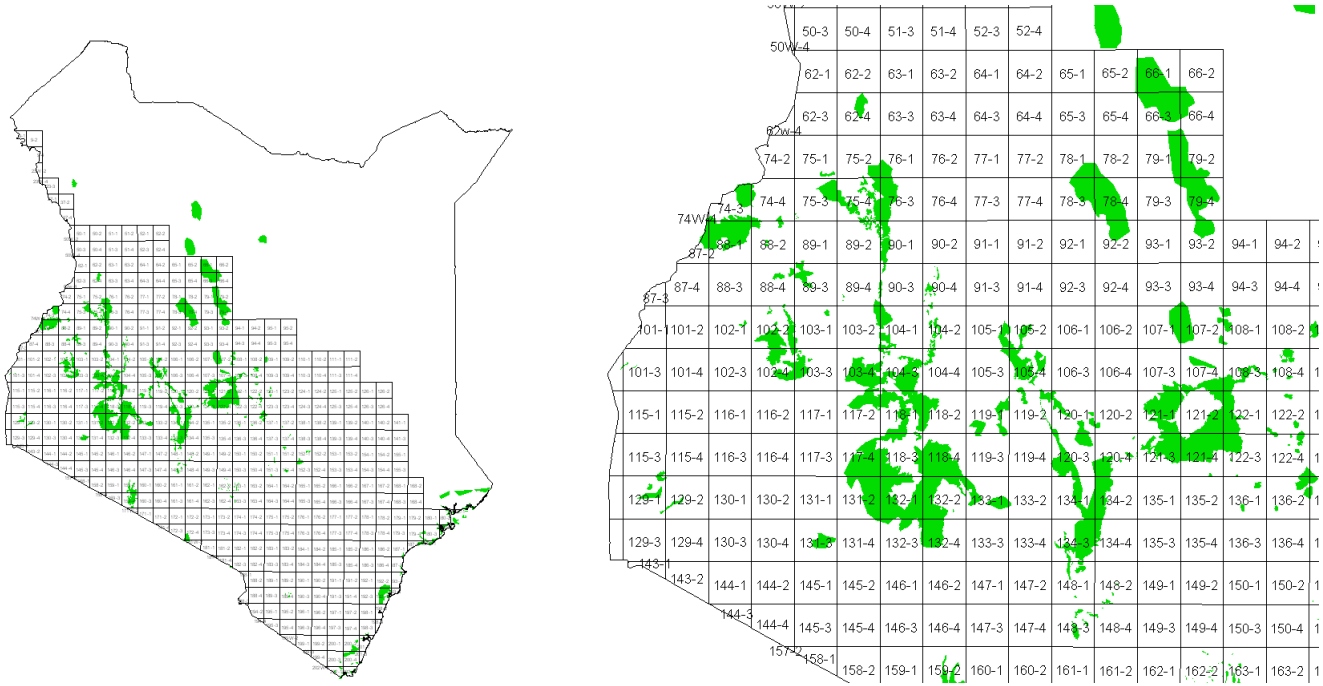


Figure 13: Image Processing & False Colour Composite Image

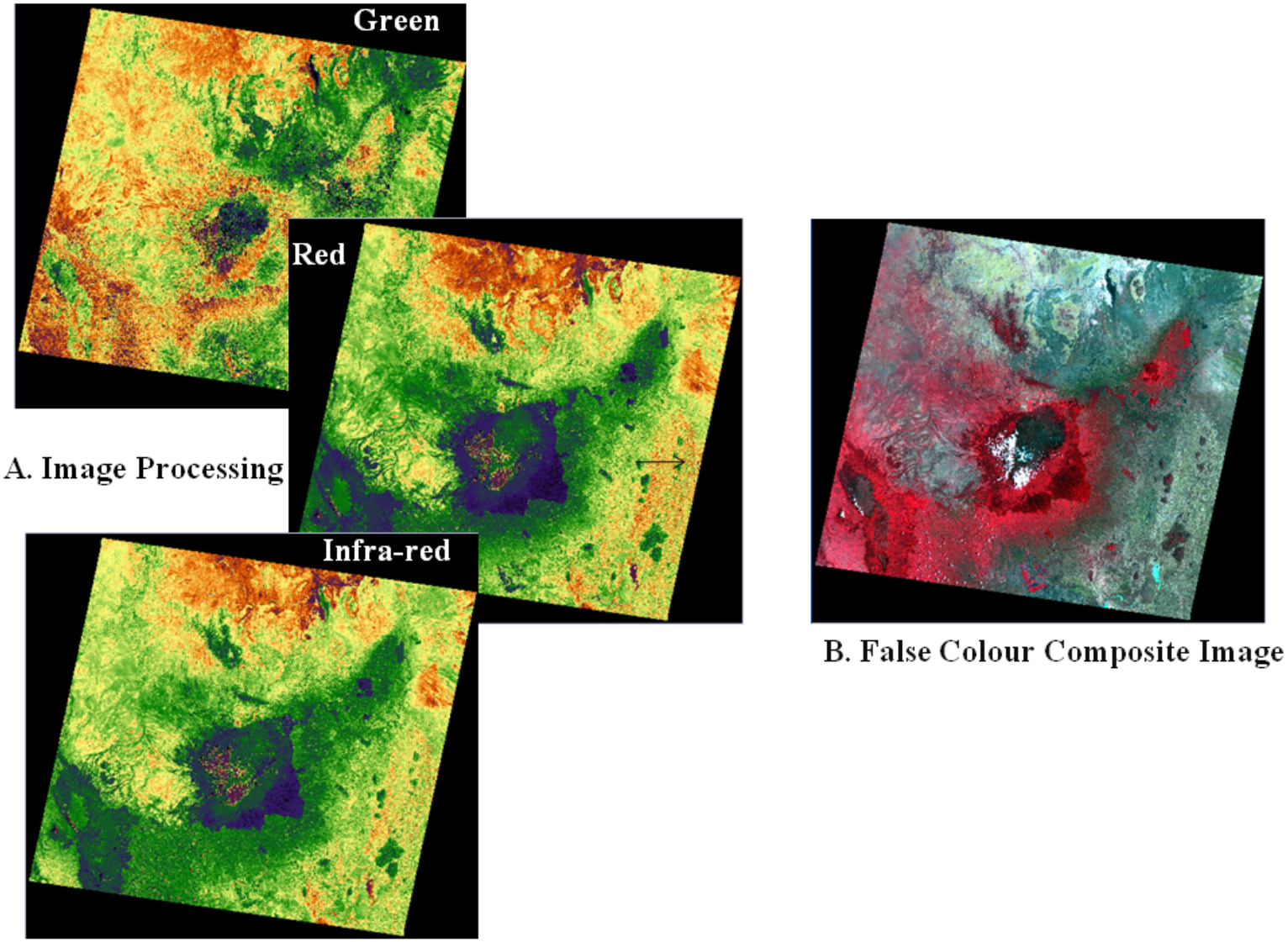
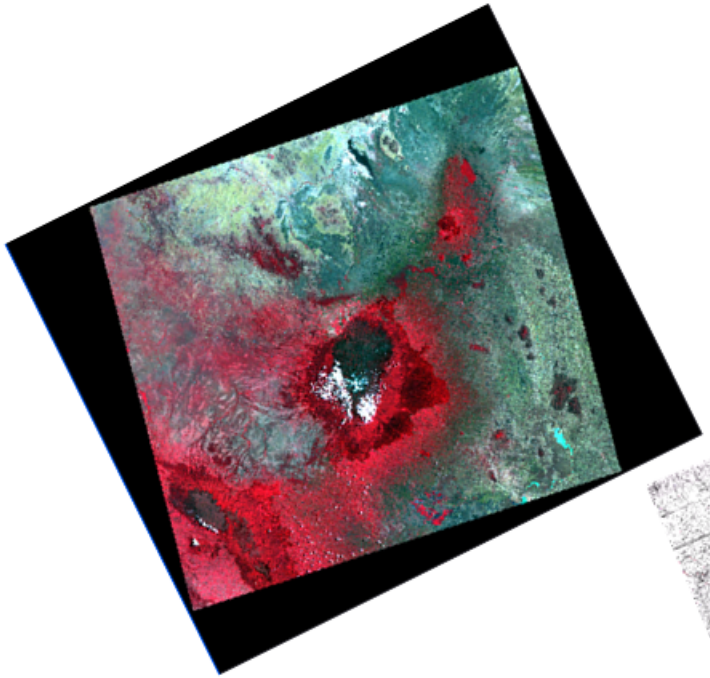
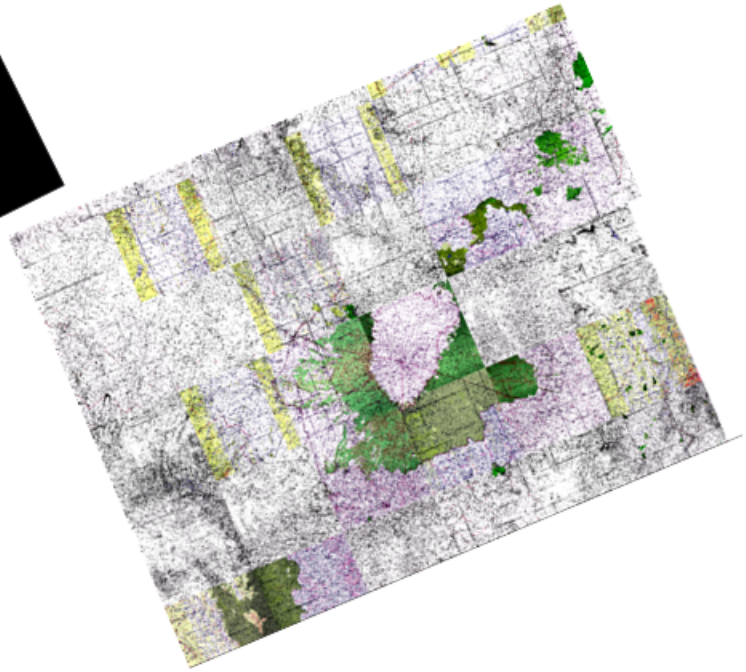


Figure 14: Geo-referencing with Topography Maps



A. False Colour Composite Image



B. Mosaic of Topography Maps

Figure 15: Supervised Maximum Likelihood Classification & Constituency Extraction