Highlights

- Global drivers of deforestation mask local-scale complexities
- Drivers and mechanisms of deforestation around Budongo and Bugoma are local and varied
- Comparison of forest loss between locations reveals different migration and agricultural dynamics
- Debate about forest loss might benefit on a refocus towards what works for forest preservation and recovery

Revisiting the Drivers of Deforestation in the Tropics: Insights from Local and Key Informant Perceptions in Western Uganda

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Abstract

Deforestation has been widespread in the Northern Albertine Rift Landscape in rural Western Uganda. In this paper, we present perceptions from local residents and narratives from key informants on causes of forest loss during a 30–year period between 1985 and 2014. While the generic drivers we find are consistent with previous literature, we suggest that the specific context in which forest cover is lost in rural areas is path dependent, and this is vital for adequate management. In the Ugandan case, the history of the sugar industry and its relation to local political drivers and international considerations (e.g. biofuel) are prominent. Global drivers of forest loss therefore mask local-level complexities, but an amalgamation of local-level dynamics does not necessarily sum up to larger-scale manifestations (in a linear manner): striking a balance between understanding local-level and large-scale dynamics could be key in addressing the deforestation conundrum. We surveyed 263 households in 7 parishes around Budongo and Bugoma forests, and conducted 22 key informant interviews. Our findings indicate that the drivers and mechanisms of deforestation are local; they also vary between Budongo and Bugoma. Key amongst these include: agricultural expansion (28%–58.5% of the responses)—with large-scale commercial and small-scale subsistence farming significant around Budongo and Bugoma respectively; "poverty" (26%–76%) often alluding to heavy dependence on forests for livelihoods. Others include: population growth driven by dissimilar migratory patterns; and moving protected forest boundaries. Our data suggest that that a combination of both local and key informant perceptions is instrumental in filling data gaps where a dearth of information is prevalent (especially around Bugoma forest), and is important for corroboration of other scientific data (e.g. remote sensing). However, a survey of wider literature indicates that there are significant issues missing from their stated views. While the continued expansion of cash-crop farming and lack of inclusion of local people in forest policy continues to raise concern, the stability of protected forest (i.e. Budongo and Bugoma) is encouraging and suggests a refocusing of the forest debate on practical working schemes for forest preservation and recovery might be the way forward for sustainable forestry and livelihoods.

Key words: *deforestation, drivers, agriculture, migration, local perceptions, Uganda*

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1. Introduction

Deforestation in the tropics continues to be a major threat to biodiversity, climate and livelihoods (Bala et al. 2007, Miles and Kapos, 2008; van Vliet et al., 2012, Achard et al. 2014). Geist and Lambin (2002) reviewed the reported drivers of forest loss across the tropics in the 1990s: they categorised these into proximate (e.g. infrastructure extension, agricultural expansion, and wood extraction) and underlying causes (e.g. demographic, economic, technological, cultural, policy and institutional: Figure 1). Whilst this categorisation was a valuable contribution, it could be criticised for being generic, covering multiple countries in the tropics. This may mask real drivers of forest loss where more local-level complexities are ignored (Angelsen and Kaimowitz, 1999). This can lead to both inappropriate policy prescriptions and /or management strategies that are insufficiently tailored to actions that will be effective in the local context (Fisher et al 2018). In this paper, we unravel some of the nuances in the drivers of deforestation considering local–level variations in the Northern Albertine Rift Landscape. This region underwent widespread forest loss between 1985 and 2014 as we evidenced using remote sensing imagery and 'ground-truthing' (Twongyirwe, et al. 2015). To detect the local perceptions of the causes of this forest loss, we report survey data and narratives by key informants including elderly residents (>70 years) that have witnessed the landscape evolve over the study period.

Figure 1: Drivers of land use and land cover change (re-drawn from Geist and Lambin, 2002) here

Local and key informant perceptions on the historical and current status of forest cover can shed light on deforestation, forest gain and forest stability (Sheil and Wunder, 2002; Sunderlin et al., 2005; Agrawal, 2007). While local perceptions are often context–specific in nature, enhanced by individual and group interaction with their socio-ecological settings, and often a basis for rural survival (Dei, 1993), this information base accrues credibility from feedback–based learning (Thompson and Scoones, 1994; Chalmers and Fabricius, 2007). Key informant perceptions (in some cases from experts on the subject), on the other hand, are often grounded in theory, attained as a result of deep understanding, practice and interaction with the subject matter (Chalmers and Fabricius 2007; Martin et al. 2012). These information constructs are especially beneficial in under–researched areas and where evidence from scientific techniques such as remote sensing produces fuzzy results. Although remote sensing can provide quantities of forest cover change (useful in informing management strategies), we cannot obtain causal information from these data; this can be perhaps be revealed from interviews with local people and key informants. Local people have understandings of land use and forest cover trends and causal mechanisms, which provide rich, contextually specific detail to complement the perspectives of key informants with local expertise on forestry issues: a combination of both information bases may therefore prove useful.

The merits of local perceptions are not without criticism in the literature. On the one hand, some scholars argue that local perceptions are fragmentary, partial, and provisional in nature, often emerging from localised experience shaped by cultural, economic, environmental, and socio-political factors (Thompson and Scoones, 1994). Furthermore, information from local informants is loaded with ethical and methodological challenges which may obscure its interpretation, and its

complementarity to other kinds of science is not always obvious (Chalmers and Fabricius, 2007). Methodological complications may include assessing whose perceptions should be considered credible; the males' or females', rich or poor, old or young, native or migrant (Thompson and Scoones, 1994). Also, how questions are framed during data gathering could affect the answers, and requires careful ethical consideration. Furthermore, literature on positionality highlights that the interviewees can be affected by their perception of the interviewer, while the interviewer could introduce his/her own bias (Kahan *et al.*, 2008; Rice *et al.*, 2015).

Key informant perceptions on the other hand may be biased by the definition and selection of key informants, their experiences in the study area, and their disciplines (and academic qualifications). For instance, an agriculturalist may highlight agricultural causes as the leading drivers of deforestation or downplay the role of agriculture in this negative context while a political scientist may highlight the historical political unrest in the region as the key driver of forest loss in the landscape. An elderly local leader who has witnessed the processes in his/her local village over the study period may be the 'key informant', best placed to provide a detailed account of what happened and why. "Key informants" in this paper therefore refer to people that are able to provide a detailed account of the landscape forest and land cover changes.

The main aim of this paper therefore is to examine local and key informant perceptions on the drivers of deforestation around Budongo and Bugoma over a recent 30–year period (1985–2014) and to try to interpret these to fill knowledge gaps given their necessarily partial nature. The aim has been largely motivated by our extensive remote sensing research over this region. The paper is structured as follows: next, we provide a context within which the study is premised, followed by a description of the methodology. In the results section we present perceptions of the local residents – from the survey, as well as detailed narratives from key informants to enrich survey data. The discussion section illuminates potential reasons for the variations in the data, and provides critical perspectives in the light of peer reviewed literature.

2. Context

2.1 Deforestation in Uganda

Deforestation in Uganda is not new in academic literature. Even though earlier literature relied on anecdotal evidence, it points to the loss of "vast" expanses of forest in the 19th century particularly for settlement and agricultural expansion (Struhsaker 1987). Since the early work, there is mixed progress on restraining deforestation; in some places, especially the conservation areas, protection has largely been successful, while in other places, forest loss has been on the rise, especially on privately owned land (see Obua et al 2010).

A good overview of the history of policy frameworks regarding forestry can be found in Galabuzi *et al.* (2015). The authors point to the changing policy and legal frameworks that either strengthened forest protection or exposed forests to encroachment and depletion. The first forest policy was developed in the 1920s, which resulted in the gazettement of, for instance, Mabira in the 1930s, and focused on

fortress protection, under the auspices of the colonial government (*ibid*). Policies that followed between 1940 and 1970s had mixed emphasis on forest access and management, and virtually no management in the 1970s and 80s when the country underwent a period of political turmoil. Policies and legislation between 1988 and 2007 restored forest protection, albeit with varying focus, mixing management regimes: collaboration and exclusion (Galabuzi et al., 2015). Even under a stable government, deforestation has continued. Examples include: rapid forest conversion for coffee production around Mt. Elgon in eastern Uganda (Petursson et al. 2013); making (illegal) livelihoods from harvesting forest timber, and non-timber products in the protected forest of Rwenzori National Park in western Uganda (Tumusiime et al. 2011); conversion for sugar cane farming in Busoga (Martiniello, 2017, Obua et al 2010); and Oil Palm on Bugala Island (Mwavu and Witkowsi 2008, Obua et al 2010).

Deforestation has also been reported to be rife in the forests located on protected and private land around Kibale National Park in south-western Uganda. These losses are attributed to charcoal production (with preference for old–growth hardwood tropical species), high fuelwood demand by the tea industry, settlement and agricultural expansion (Twongyirwe *et al.*, 2011), although Jagger et al (2012) also point out the involvement of migrant loggers. Loss of forest cover around Bwindi impenetrable forest in south-western Uganda was mainly attributed to agricultural expansion and ambiguous forest boundaries (Twongyirwe *et al.*, 2011).

There is however evidence of successful forest protection in some National Parks and Forest Reserves by Uganda's designated forest authorities, for instance: Bwindi impenetrable forest (Hamilton et al. 2000), Budongo and Bugoma forests (Twongyirwe, et al. 2015). The latter seems to agree with earlier work on Budongo that found the forest cover extent to be stable, by contrast with the situation further to the South-East in Mabira, where some 24% of forest cover was lost between 1976 and 1986 as a result of small-holder agricultural expansion, although there are some signs of more recent recovery (Lung and Schaab 2009). There are various other parts of the country with recovery and gains (as well as forest stability) mapped between 2000–2012 in a global forest cover change mapping exercise (Hansen et al. 2013).

Plantation forest using non-native species was reported to be expanding on some private landholdings with funding support from various initiatives. These include: PlanVivo Projects (run by ECOTRUST Uganda), FACE Foundation Forest Rehabilitation Project, Nile Basin Reforestation Project, and Namwasa Forestation Project (for detailed description, see Jindal et al. 2008; Peskett et al. 2011), although the effects of these types of project, at least in some cases, remain contentious (Westoby and Lyons, 2016, Cavanagh and Benjaminsen, 2014). Although plantations may be of non-native species (see below with regard to pine), these may then be re-invaded by native species if left undisturbed (Omeja *et al.*, 2016). Indeed, plantations can have complicated histories, as in the case of Butamira, where the natural forest was designated to be cleared in 1949 for Eucalyptus plantation by Kakira Sugar Works, but by 2001 was viewed as a valuable ecosystem in its own right despite being composed largely of an exotic species (Manyindo *et al.*, 2001). The case became mired in political controversy, with a battle between the revived sugar works, seeking to clear the land again for sugar

plantation, and those granted permits to farm trees, being played out in the Ugandan parliament (Tumushabe and Bainomugisha, 2004).

In addition, numerous projects for Reducing Emission from Deforestation and forest Degradation (REDD) were under incubation in the 2000s (Xavier Mugumya, *pers. comm*), but these never really took off because of ambiguities at the international level. At the national level, REDD has undergone a scoping exercise funded by the World Bank, UN-REDD, and from the Norwegian Government (Twongyirwe *et al.*, 2015). However, as Jagger (2014) points out, in the Western Ugandan region (Budongo, Bugoma and Rwenzori) lack of land tenure and property rights *awareness* may make REDD+ implementation difficult. While afforestation and reforestation efforts are on the increase in Uganda, it remains unclear what impact they are having on reducing pressure on existing forests (Ainembabazi and Angelsen 2014).

Within the Northern Albertine Rift Landscape, studies of forest loss (especially around Bugoma) are limited. Indeed the published work does not provide a comprehensive picture, with data capturing small portions of the land area and providing evidence in what at best is a fragmented fashion, especially around Budongo forest (Nangendo 2005; Jagger, 2008). The reasons for forest loss around Budongo are attributed to agricultural expansion, population growth, illegal timber harvesting, unclear land tenure systems, and weak forest protection enforcement (Plumptre *et al.*, 2007). Controlling deforestation in forests located on private land in this area was reported to be problematic particularly due to the land tenure system that grants the owner full discretion on use and disposal (Plumptre *et al.*, 2007). Earlier published work in the Journal of Rural Studies by this article's authors reported on the extent of forest loss within and outside the protected forest estate and found that protected forests had remained intact whilst virtually all forests on private land holdings had been cleared (Twongyirwe et al. 2015, 2017). We expound on this point in the next section before delving into other contextual issues surrounding forest loss in the landscape.

2.2 The Study Area in Context

The study was conducted in the Northern Albertine Rift Landscape (NARL) in Western Uganda. This iconic landscape lies approximately between 1˚18′–2˚11′N and 30˚40′–31˚52′E with an estimated area of 14098.9 km^2 (Figure 2). It is endowed with the largest area of natural forest in Uganda (Budongo and Bugoma), with rich biodiversity (Goodman, 1961; Plumptre *et al.*, 2007; Mclennan and Plumptre, 2012), but has suffered extensive deforestation (Twongyirwe *et al.*, 2015). Remote sensing evidence constructed in Twongyirwe (2015) shows that forest loss around Budongo was mostly driven by commercial sugarcane expansion (Figure 3), while small-scale farming accounts for most of the forest loss around Bugoma (Figure 4).

Figure 2 Location of study area in the Northern Albertine Rift Landscape (here)
Figure 3 Spatial patterns of land use and vegetation cover classes in the Budongo region (here)
Figure 4 Spatial patterns of land use and vegetation cover classes in the Bugoma region (here)

Management problems have been increased by splitting forest categories into different management regimes. The separation of forest management regimes followed the National Tree planting Act of

2003 that allowed protected forests to be managed under either National Forest Authority or Uganda Wildlife Authority (or both), while private forests are managed under District Forest Services (Muhumuza et al. 2007, Galabuzi et al 2015, Uganda National Forest Plan 2014). The districts have jurisdiction over forests on private land, and any forest clearance has to be licensed. Provisioning of licenses is driven by the need to generate local revenue. Broadly, forestry management bodies are largely uncoordinated, sometimes with conflicting agendas and mandates (elaborated in Twongyirwe et al. 2015). This weakness is often exploited by illegal loggers.

The protected forests (Budongo and Bugoma) are under the auspices of the National Forest Authority, managed by forest rangers and conservation managers. All forests outside the protected forest estate are under private ownership. Owners have the right to cut down trees for timber at their discretion, although incidences of encroachment of the protected forest have been reported (in this paper). The sugarcane outgrower scheme has been a key attraction to change land use around Budongo. These issues are further discussed below. The story of sugarcane is particularly relevant, as its effects seem to vary depending on location.

3. Methodology

The methodology combines a household survey with semi-structured interviews with key informants.

3.1 Household survey

We surveyed 263 households in 7 parishes within a radius of 0 to 15km from Budongo and Bugoma forests (Figure 2): Areas around Budongo and Bugoma were selected given that we were building on earlier research. These are part of the 706 households described in Twongyirwe *et al*. (2017) who perceived deforestation to have occurred in the 30-year period under investigation. The details of the sampling approach are elaborated in Twongyirwe *et al*. (2017). These respondents were asked additional questions pertaining forest cover change in their respective parishes and potential reasons for forest loss. The extra consideration made when asking questions regarding deforestation, because of the related ethical implications, it was further stressed that the respondents had an option not to provide a response about reasons for forest loss if they did not wish to. The average age of the respondents is 40.1±1.9 (mean±95% confidence interval). Of the respondents (n=263), 45.1% are male, while 54.9% are female. Although the respondents were on average older than (30 years) the period under investigation, because of the nature of the household survey that focused on various aspects (lasting between 45 min and 1 hr), it was not possible to obtain detailed views on drivers of deforestation from this category of respondents. It was imperative that we supplemented these data with narratives from key informant interviews. This is described in turn.

3.2 Key Informant Interviews

Because we lack detailed accounts of deforestation and land cover changes in the Northern Albertine Rift Landscape, we considered interviews the most appropriate to capture perceptions. The strength of this approach permits one to delve in-depth to explore the reasons why change is occurring and the nuances of this change. Our approach is exploratory and qualitative in nature. Our interest was in

documenting detailed accounts of occurrences of *perceived* drivers of deforestation. Twenty-two key informant interviews were conducted by the first author in selected parishes in the landscape, and in Kampala between October, 2013 and March 2014. This category comprised government officials working at the: national level (3)–working for the National Forest Authority, Office of the Prime Minister working with Refugee protection, Uganda Bureau of Statistics/National Planning Authority; district level (8)–environmental, planning, agricultural officers, researchers; local level officials (working at village and parish level): 4)–local council chairpersons, agricultural extension officers; non-government organisations' officials working at the national level (2), regional level (entire landscape: 1); an official working in a public–private partnership commercial sugar firm (1); private oil company official (1); and 2 local residents advanced in age (>70 years)–one near Budongo and the other near Bugoma. The selection of participants in the study was purposive: we especially targeted individuals with significant working experience in the landscape, or those with a longstanding memory of forest cover patterns (e.g. individuals of advanced age: >70 years). In addition to purposive sampling, new key informants were identified by their peers using a snowballing sampling technique (Conrad et al., 2011; Cuppen, 2012). This is a non-probabilistic sampling method where existing study participants identify new participants from among their acquaintances/peers (Farquharson, 2005).

The selected respondents had to fulfil the following criteria: they should have had long working experience in the landscape; or be elderly (in the society where they live), have witnessed and be able to recollect events in the 30-year study period and beyond; or have undertaken studies related to forest cover change in the landscape. The questions asked were, therefore, specific, and based on their location or speciality: however, the discussions touched broadly on forest cover patterns, plausible explanations for the observed trends, land use patterns, energy use, policy awareness and policy implementation. The interviews lasted between 30 minutes and 1 hour and were mostly conducted in English although the local dialect (*Runyoro*) was used to communicate to the locals who did not speak English.

3.3 Data Analysis

Local perceptions from the household survey were tallied (and summarised into percentages) to identify what local residents thought to be leading drivers of deforestation. We test the differences in the perceptions across the parishes around Bugoma and Budongo using a Kruskal-Wallis test.

Responses from key informant interviews were transcribed and largely presented by "category of respondent" in the results and discussion sections to avoid tracing the respondent. The transcribed data were coded and placed into themes, as far as possible. The themes emerge from the data. These were not imposed on the respondents even though a light semi-structured interview guide was used during the discussions. We then scrutinise local perceptions of the drivers of deforestation in the light of a broad literature.

4. Results

4.1 Local residents' perceptions of the drivers of deforestation

While there are significant difference in responses across all the parishes (Kruskal-Wallis test: X^2=54.7, df=6, p=0.000) regarding respondents' perceived drivers of deforestation, significant differences are more marked around Budongo (Kruskal-Wallis test: X^2=28.7, df=3, p=0.000) than Bugoma (Kruskal-Wallis test: X^2=2.8, df=2, p=0.24). Respondents who perceived forest to have declined (n=263) widely reported agricultural expansion and poverty as leading drivers of deforestation, topping the list in all parishes around Budongo and Bugoma. Of the total responses, agricultural expansion accounted for 28% and 30% in Nyabyeya (n=25) and Kibwona (n=30) respectively; and 44%, 58.5%, 50%, in Bubogo (n=34), Igwanjura (n=41) and Kyangwali (n=44) respectively. Poverty accounted for 32%, 76% and 75% in Nyabyeya, Biiso (n=41) and Busingiro (n=48) respectively; and 50% and 26% in Bubogo and Igwanjura respectively (Figure 5). 36.7% of the respondents who reported forests to have declined in Kibwona mentioned that it was due to population growth. Other factors such as declining soil fertility and charcoal burning were uniquely highlighted by 20.5% and 3% of respondents in Kyangwali and Bubogo respectively. A very small percentage declined to provide reasons for the declining trend, ranging between 2.3% to 7.3% in Kyangwali and Biiso, and none in Bubogo.

Figure 5 Local perceptions of the drivers of deforestation in parishes around Budongo and Bugoma (here)

4.2 Key Informant Perceptions on Drivers of Deforestation

Although the discussions with the local people and key informants were wide-ranging, 8 themes emerged from the interviews (Table 2). These could be interpreted in regard to how their importance as drivers or mechanisms of deforestation around the large protected forest blocks, Budongo and Bugoma was viewed by participants. The main themes identified around Budongo included: the nature of forest cover trend within and outside the protected area; agricultural expansion; and, migrants, settlement and population growth; while around Bugoma, the theme of migrants, settlement and population growth was dominant. Other more minor themes around both forests included: state of protected forest boundaries; poverty and dependence on forests for livelihood; management constraints; firewood extraction (for their livelihood) and, urbanisation. These themes are presented separately in turn starting with Budongo and then Bugoma. The quotes are italicised and presented as verbatim as possible (given the need to translate from *Runyoro* to English in some cases), and for clarification purposes, the authors' notes are presented in 'square-shaped' parentheses, "[ ]".

Table 2 Number of key informants who mentioned the "main themes" on drivers of deforestation around Budongo and Bugoma forests (here)

Theme 1: Nature of Forest Cover Trends within and outside Protected Areas

Budongo:

There was consensus amongst the respondents that the protection of Budongo forest by government is successful, and that private forests around Budongo were being rapidly cleared. A representative of a non-government organisation highlighted that, in fact, forest cover in the protected areas is increasing while there is a declining trend outside the protected areas. The mechanism of forest loss outside protected areas was reported to involve both large- and small-scale clearing. A District Forest official highlighted that "*land is cleared in one go for commercial farming of sugarcane* [using bulldozers], *otherwise most deforestation is subtle, illegal, and difficult to detect.*" An informant involved in sugarcane production reported how he had witnessed a [privately owned] forest in his neighbourhood being cleared "*in no time*" with heavy machinery to prepare for the new sugarcane growing season.

The forest protection policy was reported to have contributed to successful safeguarding Budongo forest, although efforts were being frustrated by a parallel and legal district income-generating scheme that issues licences for tree cutting. A government official working at the local level said, "*there are mixed trends* [within and outside protected areas]: *the increase in* [forest cover in protected areas after] *2004 could be attributed to the 2002 policy which produced the National Tree planting Act of 2003* [that improved demarcation of protected forest boundaries]. *The new policy was to address new challenges.* [Outside the protected areas, in addition], *pine was planted around Budongo in* [between] *2002 and 2004, with aid of development partners to reduce pressure on natural forests.* [Between] *2006 and 2008,* [however], *forest encroachment was due to political influence* [aspirants ignored some illegal activities to gain the good will of voters: presidential and local government elections were held in 2006]. *Districts require revenues: licenses for timber cutting were issued at a high rate, and revenues* [were] *not invested back in tree planting*." Although the protection of Budongo has been largely successful, a district official noted that illegal selective harvesting of large hard wood species was ongoing in the forest interior, and that a few private forests were being successfully managed [a contradiction that forests are being cut]. He noted the tree planting scheme by Kinyara Sugar Works (a large sugar company near Budongo forest) to boost tree coverage for instance.

Bugoma:

Deforestation outside the protected areas was reported to be patchy, and mostly attributed to small-scale farming of food and cash crops, including maize, rice and tobacco, among others. A district agricultural official noted, "*Small areas of private forest are cleared at a time for rice and tobacco cultivation*." During fieldwork, the first author found freshly cleared forest patches, and informants living adjacent to them mentioned that they were to be used for cultivation of maize and other food crops although they expressed concerns over the vermin menace from the neighbouring natural forest.

Forest clearing within the protected forest was reported to be increasing insecurity in the region. A district environmental official added: "*Deforestation is widespread in the Albertine region, and has been heightened by insecurity* [it has also heightened insecurity]. *Those involved in illegal logging are now using sophisticated equipment, and are sometimes armed*."

Theme 2: Agricultural Expansion

Budongo:

Expansion of both subsistence and commercial (sugarcane) farming was highlighted as a major driver of deforestation around Budongo. A local forestry official said, "*Subsistence agriculture is the predominant means of legal livelihood around the forest*" while a district planner noted that sugarcane expansion was a result of the aggressive expansion of the outgrower scheme. He said, "*Sugarcane plantations around Budongo have drastically increased in the last 10 years. The outgrower scheme started with a radius of 10km around the sugarcane plantations, and later extended to 25km, but now seems to have expanded literally everywhere. The scheme initially targeted outgrowers with 10ha of land but has relaxed the rules to include up to 2ha*." The growth of the sugarcane industry is said to have attracted many migrant workers who have settled around Budongo. "*The expansion of Kinyara sugar industry has attracted migrant workers: private farmers look for casual jobs in the factory too. Richer farmers hire labourers in the outgrower scheme*," a district agricultural official elaborated.

The rapid expansion of sugarcane production after 1995 is attributed to the reopening of Kinyara Sugar Works after closure by the previous turbulent national governments. The company has been under different management regimes with varying emphasis on the expansion of the outgrower scheme. This is elaborated by a key informant working in management role in a public–private partnership commercial sugar firm as follows: "*Kinyara Sugar Works started in 1972, and due to regime changes it collapsed in the late 1970s. It was rehabilitated in 1996 and re-opened. After opening, it was managed by 'Bukotite', and a UK board, who were the leading company at the time. They concentrated on the sugar estate. 1500 tonnes of sugar was produced per day by 1996, and outgrowers were few at the time, contributing between 3000 to 4000 ha, although sugar production had increased up to 50,000 tonnes/annum by 2006. In 2006, the government privatised the company, and remained with 51% shares while the 49% was taken by the 'RAI' group. Between 2006 and 2008 a new management team, SMC senior management consultants, was hired from Mauritius; they maintained the management plan, and remained at the same production levels, but the expansion plan fell through. In 2008, a new team (Agro-management Resources, UK) came in and exploited the potential in the area. They surveyed and looked for untapped potential: coffee was on the decline, having suffered from pest and disease infestation, they provided sugarcane as an alternative, and the outgrower scheme grew from 15,000 ha to 20,000 ha: increasing at a rate of an additional 3,500ha of new land from 2010-2013, in a radius of 35-40km. Land belonging to the company alone is 8,600ha. The annual production of sugar currently stands at 100,000 tonnes per annum* [at the time of the interview]*. In the outgrower scheme, the owner registers his/her land, and Kinyara covers all costs of opening it up, weeding, seedlings, and costs are recovered at harvest time when cane is supplied to the factory. The contracts go up to 5-6 years with 3 ratoon*[1] *crop harvests*."

[1] Sugarcane is a ratooning crop, where new shoots spring from the stem and mature in a period of about 1 year. Once the mature sugarcane is harvested, new shoots sprout from the underground stem without having to go through the entire clearing, and planting process. Fertiliser application and weeding are the main agronomic practices undertaken during the growing season. When 3 ratoons are harvested, land is sometimes re-cleared, to prepare for a new planting campaign.

He added that the outgrower scheme is considerate to household food security, and has a wide range of socio-economic benefits: "*The outgrower scheme radius increased to >35km to allow farmers some space for cultivation of food crops. The company has > 2000 employees:* [of which] *cane harvesting* [employs] *450, clearing 400, drivers 300, loaders 400-500, guards 1000. These are from different parts of Uganda: the agriculture wing alone has 6 sectors: estates, outgrower, engineering, harvesting, agronomy and haulage. In collaboration with NFA* [National Forest Authority], *Kinyara plants trees. Other company social corporate responsibilities include road construction and maintenance; sponsors schools (2 primary and 1 secondary in the estate); health centre for employees and community; training centre for 60-70 students for 2 years; sports (Kinyara football club); radio sensitisation campaigns on wide-ranging topics; contribution to local district activities and taxes. The company is only closed for 2 months between October and November for maintenance every year*."

The contribution of the sugarcane industry to livelihood quality around Budongo was however criticised by an official working for Bunyoro kingdom (a cultural institution) for not doing enough to provide for the households to reduce the rate of deforestation. She said, "*Sugarcane growing has benefitted communities financially, although has contributed to neglect of their cultural roles (e.g. raising children). Money from sugarcane is not sufficient to meet family needs, and communities living near forest boundaries take advantage* [of the forests to supplement their livelihood]".

Bugoma:

Expansion of farmland is reiterated as a key driver of forest loss. A district agricultural official noted: "*Farmers clear the forest mostly for subsistence farming. A range of crops is grown for food and the surplus is sold for cash; cassava has remained a staple food in some areas. Most labour is provided by family members* [who have a large] *household composition* [of] *7 to 9 members on average*." Another district official working in agricultural extension added that the crop types in the rural areas near Bugoma and peri-urban areas in Hoima are largely similar, except for the farm size variations: "*Crops grown around Bugoma are similar to those grown near Hoima town. Plot sizes are not very different, although around Bugoma, the population density is lower, and so people can practice shifting cultivation. Around Bugoma households own larger spaces, even up to 7 acres* [2.8ha], *compared to around town where averages could be less than 1 acre [*0.4ha] *for cultivation*." The increase in rice growing around Bugoma is only recent though, with its promotion through government programs to alleviate household poverty. A district official working in agricultural extension noted: "*The real boom for rice cultivation started around 2003. The NAADS* [National Agricultural Advisory Services] *program promoted its adoption, and now there is a rise in the number of privately owned* [rice] *processing mills from 3 to 70 in the last 10 years*." "*Tobacco farming around Bugoma has been boosted by the readily available market from British American Tobacco*," noted a district agricultural official.

Theme 3: Migrants, Settlement and Population Growth

Budongo:

This theme stood out with some key informants strongly believing settlement patterns have had a key role in deforestation patterns around Budongo: particularly noting that migrants inhabit forested

regions and exploit the natural resource for their livelihood while natives settle further away from forested regions, and are therefore less likely to be involved in deforestation. A respondent from a civil society organisation said, "*Culturally, it was a taboo for the natives* [Banyoro] *to cut down trees, and they naturally settled far away from the forests: most deforestation around Budongo is carried out by immigrants*." She elaborated this with an example of their settlement patterns: "*Banyoro are the dominant people in Masindi. They do not want to stay far away from each other; they lived far away from the park, hence their distribution in Masindi is far from forest boundaries*." The reason for the large influx of migrants is related to a view that natives are tolerant and welcoming. "*The natives* [Banyoro] *are some of the most accommodative peoples in Uganda: they allowed immigrants to come and settle into their region with no conflicts, such that when people come, they do not want to go*," she added.

Most of the migrants around Budongo are reported to have come from conflict-laden Democratic Republic of Congo and northern Uganda. A district planning official elaborated, "*The movement patterns of Congolese into the region around Budongo dates back to the 1960s when insurgency started*: [this movement has remained to-date]. *Other internally displaced people are from conflict-stricken northern Uganda. Those who settled around the forest cleared it for small-scale farming. The refugees depend on the forests for their fuelwood, and charcoal making, where they obtain hardwood species by selective illegal logging*." Another district official working in the environment office further explained the nature of movement and its relation to forest loss: "*Uganda has porous borders via Lake Albert, and Congolese move in and out, and cause deforestation. They deplete but are not the buyers: these* [buyers] *come from far, in Masindi, Kampala and other areas. The problem is cyclic: they are paid little which keeps them in poverty, while the middle men earn more*."

There was also consensus that the population around Budongo forest has grown over the last 30 years, as a result of the high fertility rates and a reiterated role of the influx of migrants. A district official noted, "*The human population has drastically increased in the landscape and nationwide due to the high fertility rates: particularly, around Budongo, migration patterns have had a role to play in population growth, with many migrants coming from eastern Congo*." A local forestry official estimated this growth to be high. He said, "*Population in Uganda is increasing at a rate of 3.2% per annum, and yet the per capita land availability is not increasing. People are looking for more land for farming, and as a result, forests are encroached on*."

Bugoma:

Migration and settlement patterns around Bugoma are particularly complex, with a mixture of immigrants from within and outside Uganda. Immigrants from southern and south-western Uganda (e.g. Bagika) are more common around Bugoma, while immigrants (especially refugees) from other countries (e.g. DRC, Rwanda, Sudan, Somalia, etc) are located in well settled refugee camps and communities.

A local resident confirmed that indeed, areas around Bugoma were mostly forested 30 years ago. He said, "*In 1980, there lived only 3 families in Kabwoya* [parish adjacent to Bugoma forest]. *All this land was forested. This area was part of the area where President Museveni* [the incumbent president who took power in 1986] *fought previous regimes*." But immigration contributed to rapid forest clearance.

A district official who grew up around Bugoma forest added, "*Forest depletion is due to population pressure. I grew up and went to school in Kabwoya in the early 1990s. The population was sparse and a lot of the land was covered by thick bushes and short trees. The land was idle until as recent as the 2000s. People started to come in and captured 10 to 20 ha of land per household. Wild animals that destroyed crops were many at the time. The Bakiga came in with their relatives and split the land amongst themselves*."

An elderly informant (about 70 years old) who is also an immigrant confirms the previous assertion, and attributed the majority of the forest loss around Bugoma to settlement patterns where land was allocated "free-of-charge" in the past. He said, "*I moved into Kabwoya from Mbarara [in SW Uganda] about 20 years ago. I cannot recollect the exact date but what am aware of is that the current president had already taken power. I did not have to pay a single coin for this piece of land. At the time, the local council chairpersons demarcated plots for whoever wanted. It was all forested, and the bushes were thick. I acquired over 3 ha, and the challenge then was to clear the forest for settlement and agriculture. I cleared this slowly over time. The hardwood trees I sold provided money for my basic survival. The crops were frequently raided by baboons from the natural forest. This large expanse of my neighbourhood was all natural forest 20 years ago: it is now all settled on and farmed, and the natural forests are no more*." His assertions are also corroborated by a district official working in the statistics office who highlighted migration patterns and the influence of migrants on deforestation: he said, "*Settlement patterns are influenced by migrants: in the early 1990s, areas around Kyangwali and Kabwoya were forested and vacant – it was initially thought that it was a forest reserve and communities discovered that it wasn't – people have since encroached on it and converted it to agriculture – migrants are mostly from Kigezi and Kisoro* [in SW Uganda]."

Conflict in the neighbouring countries is the cause of an influx of refugees in Kyangwali Refugee Camp (near Bugoma), but these are organised in settled (and gated) communities, and are less involved in affairs outside. A respondent (working at national level in the office of the prime minister) argued that it was therefore difficult to attribute the ongoing forest loss to them although some cases were found, and culprits were prosecuted in court and returned to the camps. A government official working at the national level in the office of the prime minister said, "*Refugees are relocated in camps in Kyangwali* [in Hoima district] *and not in communities* [outside the camp]*. It currently accommodates approximately 38,000 refugees* [at the time of the interview]. *98% are Congolese, followed by south Sudanese, Rwandese, Kenyans, Burundians and Somalis. Each refugee is allocated a 50m by 50m plot where they settle and cultivate. Once in the camp, they can live there for as long as they are in Uganda. Spontaneous returns to their countries are illegal. Within the camp, refugees* [can] *clear the vegetation to settle. They are not involved in many activities outside their camp*: [however], *they can do odd jobs, but are not allowed to settle outside the camp. Non-Ugandans living outside the camp are not necessarily refugees*."

Similar to some key informant responses on the role of the natives around Budongo, there were suggestions that natives around Bugoma are mostly cultivators and are less likely to be involved in deforestation. A district agriculture official said, "*The indigenous Banyoro are mainly cultivators and settled along the road network. Land in Bunyoro has been idle for a long time, and Bakiga* [from SW

Uganda] *came in to cultivate it since Banyoro were not taking advantage of it. One could for instance sell 5 acres of land in Kabale* [SW Uganda] *and buy 100 acres in Bunyoro as it was also cheap at the time*."

Theme 4: State of the Protected Forest

Budongo:

It was reported that forest boundaries are clearly demarcated [these were visible during fieldwork indeed], and that this has had a role in the successful protection of Budongo. A local forest official elaborated as follows: "*Budongo forest has clear boundaries*; [these are marked by] *a river, main road, sign plates, corner posts*, [and] *direction trenches: these separate forest from community land*." A district forestry official further stressed that emphasising the forest boundaries followed a reform in the forest sector although this resulted in making previously sections of protected forest to lie on "private land" which accelerated forest loss right up to the protected forest boundary. "*National Forest Authority delineated boundaries following the forestry sector reform in 2003, and some parts of the forest that were initially protected were opened to private owners who were largely disorganised which increased deforestation*," he said. Although the boundaries of the protected forest are clear, the respondents further stressed on-going illegal logging of hardwood trees. A local forest official noted, "*Budongo has diverse tree species of communities' interest; for instance, mahogany is used for boat making. Depletion is mostly inside the protected forest for particular species, and not at the boundary*."

Bugoma:

Successful protection of Bugoma is attributed to clear boundary delineation and community sensitisation. This was reported to allow fresh forest growth and regeneration in places. "*Sensitisation* [of the communities on the protected forest boundaries] *improved boundary maintenance, and allowed regeneration of forest in the western boundary of Bugoma*," a district forestry official stressed.

Theme 5: Poverty and Dependence on Forests for Livelihood

Budongo:

Poverty [not defined by the respondents] was a theme emphasized by 4 key informants (Table 2). They argued that people who live near Budongo are impoverished and heavily reliant on forest products for their livelihoods. A local forestry official said, "*People around the forest are heavily impoverished. The carry out selective logging of trees for charcoal, timber and poles for building, and curing tobacco using pitsaws*. *Tree species like Mahogany are now scarce in the forest*." Another forestry official further stressed, "*People living around the forest are poor and vulnerable with many malnourished children. They own small plots of land and occasionally seek for odd jobs from Kinyara sugar industry, and are paid little. Some still live on less than a dollar a day. Seasons are changing and crop yields drastically declining. They cut down trees with a view to be alleviated from poverty*."

Bugoma:

Not mentioned.

Theme 6: Management Constraints

Budongo:

This was one of the least mentioned themes related to deforestation in and around Budongo forest, with only 3 respondents highlighting it [possibly because this is not the kind of thing local people would talk about]. Management of Budongo is militarised to keep illegal loggers at bay, but understaffing and limited funding undermine conservation efforts. A local forest official noted, "*NFA* [National Forest Authority] *is understaffed and cannot keep all illegal loggers at bay. There is for instance only one vehicle used for the management of the entire Budongo forest. Environmental protection police and the army* [Uganda People's Defence Forces] *are supposed to provide enforcement but their activity on ground is thin*." It has a limited number of staff; the locals are aware about this and exploit the gaps. Another forestry official noted, "*Deforestation is seasonal. For instance* [during] *public holidays over Christmas, charcoal and timber loggers take advantage of reduced forest surveillance*." The new forestry policy and Act is blamed for creating further management problems. A district official elaborated as follows, "*Forestry policy shift created a management vacuum in 2003 and pieces of forested land were grabbed for sugarcane plantations. There has been some minor recovery through planting trees but natural forests have not recovered*."

Bugoma:

Not mentioned.

Theme 7: Firewood Extraction

Budongo:

Only 2 respondents talked about firewood extraction from Budongo as a threat to the natural forest and as a key driver of deforestation. A forestry officer said, "*Locals around the forest use firewood mostly for cooking, obtained directly from the forest – this is acceptable – although as they search for the fuelwood, they then spot hardwood species which are later illegally felled. Fuelwood gathering, if is not well regulated, contributes a lot to deforestation*." This is reiterated by another forestry official, "*Firewood collection is a threat to forest cover. Riverine forests (e.g. Nyamusabo, Nyamageta) used to be fully stocked, and were used for firewood [gathering]; these have now been cleared. Communities now move* [from] *as far as 10km away to gather firewood from Budongo. In some cases they throw down fresh trees to allow them dry and become firewood*."

Bugoma:

Similar to Budongo forest, firewood gathering is not considered to be a significant cause of deforestation around Bugoma. A district forestry official noted that it is in fact illegal to gather firewood from Bugoma although adjacent communities continue to do so.

Theme 8: Urbanisation

Budongo:

This was the least mentioned cause of deforestation. Growth of peri-urban centres around the forest is attributed to the growth in the sugar industry. A district official said, "*The booming sugar business has*

increased built areas around the sugar industry, for instance, Kibwona. The expansion of Masindi town too is attributed to the sugar boom."

Bugoma:
Not mentioned.

5. Discussion

In this section, we mostly highlight why generalisation by Geist and Lambin (2002) (explained in the introduction) is problematic. We provide a brief explanation of the results obtained from the survey first, followed by a detailed account of the perceived drivers of deforestation by the key informants. The perceptions of forest loss are also compared with evidence generated from remote sensing. We then put the discussion of the issues in these sections into a broader context, drawing heavily on academic literature.

5.1 Local Residents' Perceived Drivers of Deforestation

It is important to note that local perceptions of forest loss were not dissimilar to those of the key informants. Obvious differences lie in the amount of detail provided. Local residents generally noted agricultural expansion, poverty and population growth as the leading drivers of deforestation around Budongo and Bugoma forests: respondents around Budongo were more likely to highlight poverty than those around Bugoma, consistent with the key-informant ideas, although very different in terms of the frequency with which it was mentioned. However, poverty was rather ill-defined, but it may be related to dependence on forests for livelihood.

The broad patterns are in agreement with what most of the literature suggests (e.g. Majaliwa *et al.*, 2010; Twongyirwe *et al.*, 2011) and quite similar to broad generalisations by Geist and Lambin's work. As highlighted by the key informants, the nature of agriculture varies around both forests. For instance, while sugarcane is the dominant cash crop around Budongo, rice and tobacco are predominant around Bugoma. Households (e.g. in Busingiro) that perceived forest to have declined and mentioned that deforestation was due to poverty also generally earned less on-farm and off-farm incomes compared to other parishes (Twongyirwe 2015). It could, therefore, be inferred that their livelihood is mostly derived from dependence on forests. To avoid repetition of the discussion of issues raised by local residents with what the key informants said, similar issues are handled together in the next section (5.2). However, other widely hypothesised drivers of deforestation in the literature that were not mentioned by the respondents are examined further in section 5.3.

5.2 Key Informant Perceptions of Causes of Deforestation around Budongo and Bugoma

The *perceived* drivers of deforestation seem to be related to agricultural expansion, migration and population growth, the nature of forest cover within and outside the protected areas, and management regimes, with the issue of poverty and dependence on forest products bought up in

Budongo but not Bugoma. Illegal logging receiving some passing mention. Some of these have already been found elsewhere in Uganda (e.g. Majaliwa et al., 2010; Twongyirwe et al., 2011).

As highlighted by the key informants, the nature of agriculture and mechanisms for land clearance vary between the forests. While large-scale clearing for commercial farming of sugarcane currently dominates around Budongo, rice and tobacco are predominant around Bugoma along with small-scale clearing of forest patches for subsistence farming. There seem to be differences in access to agricultural inputs; where around Budongo mechanisation (e.g. bulldozers) is provided by the sugar industry, more rudimentary tools (e.g. axes, pit saws) are used around Bugoma.

Migration and settlement patterns around both Budongo and Bugoma have developed differently. Refugees and migrants are thought of in a different manner near Budongo from those around Bugoma; household survey data indicate that there is a mixture of ethnic groups especially around Budongo (Twongyirwe, 2015), although natives were more common around Bugoma. Around Bugoma, those from outside the country are currently kept in planned communities in Kyangwali refugee camp. Respondents recognise that most of the region had been forested in the last 30 years but increasing population pressure from migrant communities from southern Uganda or across the border with DRC has increased forest clearance. There seems to have been little or no barrier to land clearance or any controlling effect of land tenure for people moving into the area in the past. There is agreement that forest protection was successful in gazetted areas, and that losses are mainly outside the protected forest boundary. Some of the latter seem to have been "grabbed" for further sugarcane expansion.

Amongst the key informants, poverty and firewood gathering were some of the least mentioned drivers of deforestation. While there is a direct link between forest dependence and poverty, and rural people's dependence on biomass for cooking, given that these were less considered (and mentioned) by the key informants, it could be that they are obvious and contribute nothing new to the deforestation conundrum, or it could be that firewood gathering is embedded in complex gender relations where women's work in firewood gathering (evidenced from household time budgets in Twongyirwe 2015) is given little value – but we lack evidence that our respondents might be drawn from groups that would take such a view in this area. Firewood quantities gathered are likely to be too small to cause major forest degradation (except in extreme cases), although key informants suspected that this enables locals identify tree species of interest which are later illegally felled. Given the wide variation between the mention of poverty between regions in the survey, and rather low prevalence of its appearance in key-informant interviews, more data are required to understand the relationship between forest resource use and poverty.

5.3 Comparison with satellite observations

Perceptions of the loss of forest and expansion of agriculture from key informants are largely in line with evidence from remote sensing. Around Budongo the expansions of commercial agriculture is clear in the remote sensing between 1988 and 2002 (Mvawu and Witkowski 2008, figure 1) and continues to 2014 (Figure 3: for more details see Twongyirwe 2015). The key informants add richness

and detail to this picture and clarify that the clearing is often on small patches of intact forest at once using 'modern technology' (e.g. bull dozers). Around Bugoma on the other hand, tree loss is more subtle and more spread over time as more rudimentary techniques are used for land clearing. Often, small patches are cleared for settlement and small–scale agriculture (see Figure 4 and Twongyirwe et al 2015, Figure 12, p.248 and plate 1: p.249).

Similarly the perception that protected forest is largely unaltered in area, but that the private land deforestation goes right to the boundary, is in good agreement with satellite observation. However, while remote sensing data did not identify large sections of logged areas in the protected Budongo and Bugoma forests (Twongyirwe et al., 2015), possibly due to the difficult-to-detect scale at which logging occurred, key informant interviews highlighted illegal logging in the protected areas particularly for hardwood tree species. This suggests, in agreement with previous studies (e.g. Muhumuza et al. 2007; Nangendo et al. 2007), that there is a timber extraction process in Budongo (and Bugoma) which is at variance with the evidence that the forest area has been relatively stable: therefore the extraction is presumably selective and potentially sustainable, or perhaps the forest is being degraded by removal of large old trees, but is taking place. It is possible that some of the respondents from the (surveys and) interviews were involved in the wood extraction but did not disclose this information for fear of reprimand with the authorities. Data from another study show that deforestation around Budongo for instance, is driven by key players who are richer, large-scale traders living in urban areas (e.g. Kampala and Masindi: see Muhumuza et al. 2007) who ferry large trucks of timber, charcoal and firewood into the cities. Only one respondent highlighted urbanisation as a cause of deforestation though, and satellite studies have not so far shown a strong urbanisation signal in the study area.

Issues regarding the increase of population through migration or other factors are rather more difficult to match with satellite data. Lung and Schaab (2010) provide some rather inconclusive evidence relating deforestation to population density around Budongo (and Mabira forest to the South East), but the relationship between increasing population and deforestation is not only hard to pin down (contingent on multiple other political, economic and social factors; see e.g. Scales 2011, Carr et al 2005) but not one that can easily be inferred from satellite: direct observation on the ground is needed, but this lacks a historical context. Although the size of migrants and outgrower population and how that impacts on forests is interesting, all we have currently is the perceptions of people in the area. Future research could focus on finding the size of the migrant population although this is fraught with difficulty – defining who a migrant is, when they arrived, and their relationship with the forest across the whole population would be difficult. Establishing who is engaged in sugarcane outgrowing (or other cash crop production) and what impacts this might have is also tricky – sampling can give some information, but a full census would be more useful and likely to be more accurate (with the caveat that there would be biases depending on the census instrument and respondents'' reaction to it). So this kind of census is no simple undertaking. In any case, where historical records are thin we have to rely on the knowledge of local informants.

5.4 The broader context

Geist and Lambin (2002) in their review of the literature to that time discuss deforestation in terms of proximate causes and underlying drivers, the former being the immediate reasons for the removal of trees, and the latter being more related to the social processes that lead to this. In many ways, our study here reflects their findings: 96% of proximate causes in their literature review were associated with agricultural expansion, and of this 47% of cases were driven by in-migration (with population growth typically less important). We can see the latter as being related to the situation around Bugoma over the last 30 years. Commercialisation, economic factors and agro-technical change were also prominent, and this chimes in well with the expansion of sugarcane around Budongo. That there are multiple factors at play in the same area is also in line with their analysis. They also stress that the various factors are inter-related in complex ways, an issue that has continued to become more prominent is discussion of coupled human and natural systems, or "Social_ecological Systems" (SES) (Liu et al 2007, Ostrom 2009). In this view complex systems are thought of as having a number of key characteristics that make management difficult – path dependence, multiple-overlapping feedbacks, heterogeneity, and liability to sudden changes or "tipping points". Here we draw out some of these interconnections, noting where the points were not raised by our key informants, despite their prominence in other locations in Uganda.

5.4.1 Sugar and biofuel

Around Budongo, agricultural expansion was seen as largely due to the aggressive outgrower scheme, driven by Kinyara Sugar Works, where farmers agree to allocate considerable amounts of their land (including what was previously under small-scale farming and forest) towards sugarcane production. Other than the sugarcane scheme, the small-scale farming (in terms of land sizes and crops grown) is similar to other parishes around Budongo, and the region more generally.

The issue of deforestation in Uganda is hard to disentangle from the issue of sugar. While a serious agent of deforestation in the past (Martiniello 2017), the revival of the sugar industry since the late 1980s has rapidly gained pace. While one might initially be tempted to think that this is perhaps like any other cash crop, the situation is more complex, as we can see from a comparison of the Kinyara sugar works in Bugoma relative to Kakira sugar, further to the East near to Mabira forest. Whereas the recent Budongo/ Kinyara expansion has led to clearance of areas outside the central forest reserve (CFR), the Budongo gazetted forest appears to have been little affected, and little by way of civil conflict is widely reported. This contrasts with the Mabira/Kakira case, where the CFR has been under severe pressure, and a source of continuing conflict between local pressure groups and the central government. On three separate occasions moves have been made to degazette a large proportion of the Mabira forest in order for it to be cleared for sugarcane plantation (Hoenig 2014, Zommers et al 2012), despite there being ample other land nearby that could be exploited for the purpose. Justifications have been put forward in terms of job creation, foreign exchange and production of biofuel for energy generation (Zommers et al 2012), but it remains difficult to see why forest clearance is necessary for these aims to be met. Martiniello (2015, 2017) views the expansion at Kakira and a similar case in Tanzania as a product of agro-extractivism that exposes the individual farmers to fluctuations in global market prices, whilst promoting indebtedness, compromising food production, displacing the poorest or less competitive farmers and leading to re-alignment of traditional gender roles.

Similar stories follow the push for palm-oil production as biofuel (Koh and Wolcive 2008), including dispossession, violation of traditional land rights and changes in gender roles, although it can be difficult in some cases to be sure where natural forest has been replaced by palm-oil plantations, as opposed to re-use of or extension of previously converted land (Carrere 2013). While there are some hints of difficulty with outgrower schemes in the Budongo area (see end of Theme 2), Zommers et al (2012) found little evidence in their Budongo survey that outgrowers were either significantly benefited or disadvantaged relative to others in the area. The difference between the two cases seems to be rooted in historical variations in land use, but also in political power struggles (see the comment above about regarding Bugoma as a former refuge for the current President) as well as a need for foreign exchange. Hoenig (2014) suggests that part of the issues with Mabira is a result of distancing of relationships between the current President and former allies (and thus the targeting of the forest is a means perhaps to put pressure on the latter), whereas the history of the forest itself, with multiple different land uses and conversions/replanting (e.g. Westman et al 1989) has allowed for an argument that the forest is in any case degraded and therefore of little current value. As a further complication, there appears to be conflict between sugarcane growers in the two areas. Reports in the media speak of "sugarcane conversion" or "sugarcane poaching" in which outgrowers or other agents harvest sugarcane before it is due to be collected by the sponsoring sugar works in order to send it for processing to competing organisations and get a return in a shorter time (e.g. Uganda Radio Network 2016, Chimp reports 2018). Similar phenomena seem to have been occurring in other places (e.g. the situation in Kenya, Financial Times 2014). This has been sufficient as to make it into the president's state of the nation address in 2016, and to lead to a call for better implementation of a policy restricting new sugar works to a radius not beyond 50km of existing plants (State of the Nation 2016). Whatever the case in practice, it appears the history of both regions (in that sugarcane production, after abandonment in the 1970s was explicitly revived in the same areas after intervening years of political turbulence) has led and is leading to different outcomes, despite the similarity in the land use. Thus the current state of each location is not sufficient to assess deforestation on its own: the evolution is path dependent. It is notable that the issue of Mabira was not raised by any of our own respondents despite its high profile.

5.4.2 Militarisation, human-wildlife conflict and "clean development mechanisms"

Whilst biofuel and cash crop production is part of the story associated with forest loss, another factor that links the area to wider issues is conservation, clean development and the consequent militarisation of forested areas (Theme 6 above). The fact that a military presence seems to be necessary to combat illegal logging already suggests that policy implementation may not be well aligned with the way that people see their livelihoods on the ground, or it suggests that this is how forestry is governed at a national level in Uganda.

Furthermore, clearing of private forests outside the Budongo CFR and expansion of sugar production also seems to be increasing human-wildlife conflict. While there is evidence that traditional farmer response to local crop-raiding (both by wildlife and domesticated species) is variable by species (with baboons for example being killed and sold for meat, but chimpanzees released) sugarcane growers are seen to be more uniformly hostile (Webber et al 2007, McClennan 2008, Reynolds 2005). Loss of private forests appears to be removing forest corridors that chimpanzees would use to make their

way between Budongo and Bugoma CFRs, and to increased conflict according to reports in the popular press (East Africa Business week 2018), whereas some of the quotations :-
"*Wild animals that destroyed crops were many at the time."*
"*The crops were frequently raided by baboons from the natural forest*."
hint that perhaps there has been a general decline in wildlife prevalence in the area. In this regard, the reports above show a growing prevalence of cash crops such as tobacco and rice around Bugoma should perhaps raise some level of alarm.

Stories of violence and dispossession similarly seem to be associated with forest plantations for "Green Development" of carbon offsetting in other locations, following inward investment by developed countries, examples being forest plantation schemes in Bukaleba and Kaching (Westoby and Lyons, 2016) and carbon offsetting in Mount Elgon (Cavanagh and Benjaminsen 2013) whereas the value of CDM offsets, at least associated with sugarcane production at Kakira appear not to be living up to promise (Purdon 2014). Again, though, we heard little of such stories in the current set of interviews, apart from a mention of "land grabbing" for sugarcane. How the latter relates to the broader issue of land grabbing seems unclear: the case here seems to be driven largely by the local sugar boom, or local migration patterns, rather than particularly, for example, a larger scale push for biofuels (although sugar waste products are in use for this purpose, at least at Kakira (Purdon 2014)). None of our respondents seemed yet to fit the seven categories of foreign land grab elaborated by Zoomers (2010), for example, except perhaps for the issue of protected areas. Possible future REDD schemes, or future infrastructural development might well lead in this direction however.

5.4.3 Infrastructure and Technological issues

Development of transport networks (e.g. roads, railways), markets, settlements, public service extension (e.g. waterlines, electricity supply) and private company activities (e.g. mining, hydropower, oil exploration) were identified as key drivers of tropical deforestation in the Geist and Lambin (2002) framework. Ascertaining forest loss to infrastructure development in the Northern Albertine Rift Landscape is difficult, but notably, oil was discovered in the Albertine graben in the last decade, and the oil and petroleum bill was passed in December, 2012. Oil companies have since completed exploration and plans of production and processing are underway. A few oil wells are located in sections of the protected reserves, and many are not distant from the protected forests of aesthetic and biodiversity importance. This raises questions about their protection status over the coming decades. Urbanisation, as a result of the oil industry will likely present extra demand for forest products (e.g. timber and poles), and may drive future deforestation patterns in the landscape. During fieldwork, there were extensive road works visible in places especially where the oil refinery will be located, and main roads leading to extraction areas, although the issue of oil was hardly mentioned by respondents. It remains to be seen if these infrastructure developments will have an effect on the forest cover. Data from elsewhere (in Latin America) however shows accelerated deforestation as a result of improved road access (Geist and Lambin 2002), however, there is little evidence at present from this project that forest loss is as a result of this process. Nevertheless, the development of roads then facilitates further technological developments as heavy machinery can be brought in to accelerate the processes of land conversion. Deforestation rates are thus just not issues of facilitated land access, but there are feedbacks associated with the linkages between different technologies that

build upon the presence of road networks. These again have a temporal aspect, with the rate of land conversion being highly infrastructure dependent.

5.4.4 Information and demarcation

While the reported degree of clarity in demarcation of forest boundaries seems to have helped with preservation of gazetted areas, it also seems to have facilitated the removal of forests outside these regions, while as Jagger (2014) points out, there remains a deficit in practical delivery of information about land rights and permissions. There was clearly a feeling from our informants that past forest clearance has been made straightforward by a lack of any boundary setting, but also that changes in boundaries could lead to loss of particular forest areas. Galabuzi et al (2015) feel that a lack of involvement of local stakeholders, inequitable sharing of forest benefits, confusing and contradictory political pressures and slow reviewing of the effects of forest policy have helped to make the process of forest conservation more difficult. The role of agricultural expansion, either for sugarcane (does it disadvantage small scale farmers and increase their food insecurity?) or more traditional swidden-agriculture (which is not efficient, and may exacerbate the effects of agriculture on deforestation, as people are using more land than they actually need to, but perhaps requires relatively low inputs) or in improving rural people's welfare remains less understood; policy development needs to include the views of these people if it is to be effective.

5.4.5 Logging

Illegal harvesting of hardwood tree species is reported to be common in both forests, but we garnered little direct information about who might be involved or why. It could be due to the fact that we did not stay for sufficiently long periods in the field to witness the illicit activities or that the number of interviews were not sufficient. However, although the locals perceived illegal loggers who used pitsaws to be poor, we think that this category may not be as such, or that they could have been working for rich middle men involved in timber trading. More information on the effects of logging on the gazetted forests is still needed, as the remote sensing data currently is not able to help. This may change, however, with improved satellite resolution. Landsat data has a resolution of only 30 m, whereas modern satellites can resolve down to 30 cm, sufficient to follow the fate of individual trees.

6. Conclusion

While much of the material gathered fits the generic categories that works such as Geist and Lambin (2002) identify, and the idea that forest loss is part of a complex Social-Ecological (and Technological) System there are a number of points from the current study that suggest that a generic categorisation of drivers of deforestation in the tropics can be less than helpful than context-specific pathways.

a) History matters: the paths being taken today depend on the local context, in terms of how the present situation came about, and what the actors in the system know about the past because this shapes how they act in the present.
b) Local stakeholders need to be involved: militarisation and violent dispossession (again possibly linked to global political drivers) are two manifestations of the consequences of policy setting that does not take into account the reality of how people are using the land, and the potential conflict between their livelihoods and corporate or other actors with different

agendas from ordinary people. The effects of migration may also lead to cultural changes in the way trees are valued and to conflicts with local politically sanctioned authority, so good information dissemination is required to encourage a sustained view of the value of the forest.

c) Space matters: even within a single consistent land use, complex interactions played out in the spatial context, which maybe local manifestations of broader global processes, especially where there is history involved. Given that logging, for example, is driven by distant as well as local factors, policy needs to take into account the need to make cultural changes, and account for the effects of political connections and corruption, not just within forested zones, but in areas that have remote influence.
d) Small numbers of key informants: these may highlight particular issues, but without setting their partial views in a wider context, important issues can be missed. This may not necessarily be due to limitations in the methodology but in the local perceptions *per se*.

The future for the remaining forests in Budongo and Bugoma is threatened: the lack of emphasis of the potential effects of oil and developing cash crops by the local and key informants, and the effects of these in other parts of Uganda suggests that the area may be vulnerable, despite the stated aims, for example, of the Kinyara sugar works to encourage tree planting. Loss of the wildlife corridors and increasing conflict as a result of further clearance of forest fragments does not bode well for signature species such as chimpanzees and baboons, especially if these are regarded as vermin.

International political context is vital: the drive for biofuels as an attempt to reduce carbon footprints, coupled to (e.g. via REDD), and conflicting with, (e.g. through removal of natural forest for biofuel) the conservation agenda, has specific local effects despite acting from the larger (global) scale – using a generic framework can hide the international interconnections that make such drivers function. In addition, rates of deforestation need to be taken into account. The category of driver also changes the rate of change: where there is a policy process that is incompatible with a change in the technology, there can be loss of forest before policy can catch up (presented e.g. roads for oil facilitating use of bulldozers), and a long view is needed. It is only on the last few years, partly as a result of the 30-year time-series of satellite data that is now available (Hansen et al 2012) that we have a view both of deforestation and, importantly, forest *recovery.* There is some remote sensing evidence of recent growth (after 2010) in built up areas in previously bare regions in Buliisa, for example (see e.g. Twongyirwe *et al.*, 2015, 2017).

However, the fact that forest recovery is possible (partly highlighted in section 2.1) suggests that perhaps it is time for a more optimistic view. While the recent and continuing forest losses are not encouraging, and stories of continued logging do not make good reading, the fact that the forest reserve areas have been maintained is hopeful. Perhaps it is time to reframe the debate not in terms of deforestation, but instead begin to talk about what local management actions can effectively contribute to *forest preservation and recovery.* This needs to be combined with a flexible management approach that accounts for the constant change taking place and the heterogeneity that exists at landscape scale (see e.g. Gardner et al 2009). An inclusive approach is required, where the livelihoods of local people are fully taken into account, that addresses the issue of community differentiation (and conflicts related to differentiation /or at least difficulties for local leaders to have

authority over migrants), and ensures the presence of buffers (through alternative/diverse economic activities) that protects people from the fluctuations inherent in international markets and land use decisions driven by factors distant from the spaces where forest loss takes place. It is plausible to think that this could help to deliver long–term sustained success.

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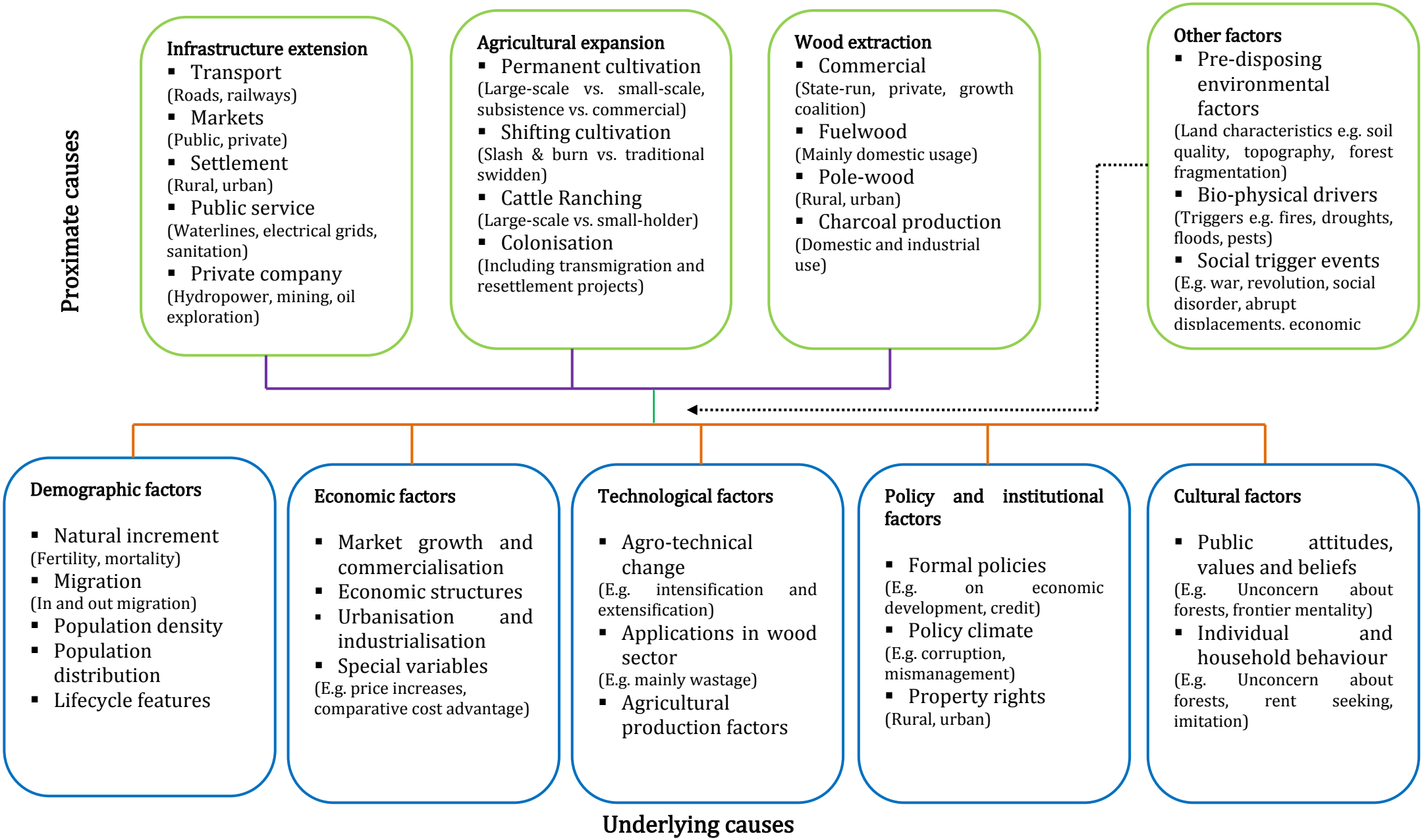

Figure 1 Drivers of land use and land cover change (re-drawn from Geist and Lambin, 2002)

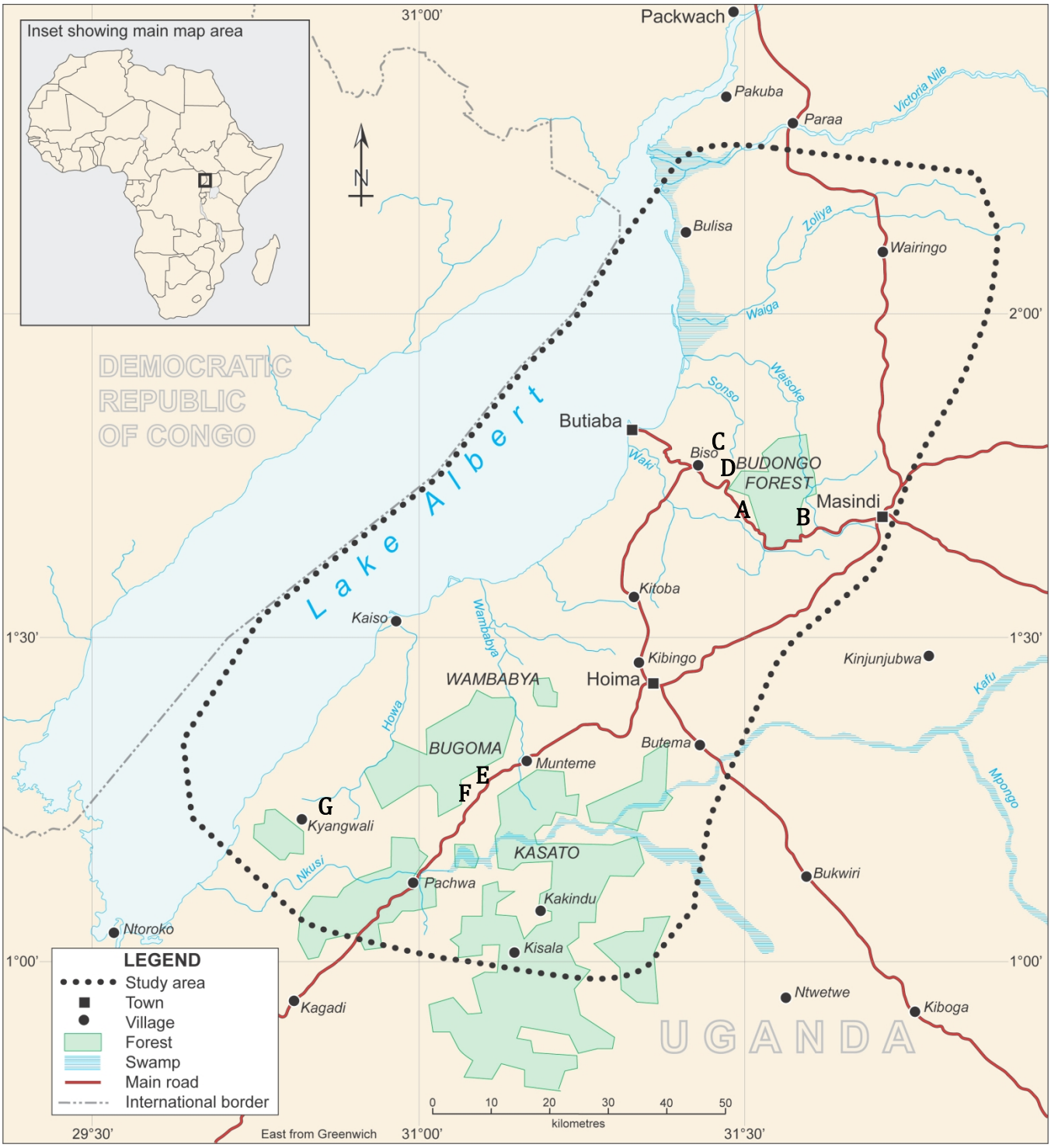

Figure 2 Location of study area in the Northern Albertine Rift Landscape (Studied parishes include: A–Nyabyeya, B–Kibwona, C–Biiso, D–Busingiro, E–Bubogo, F–Igwanjura and G–Kyangwali)

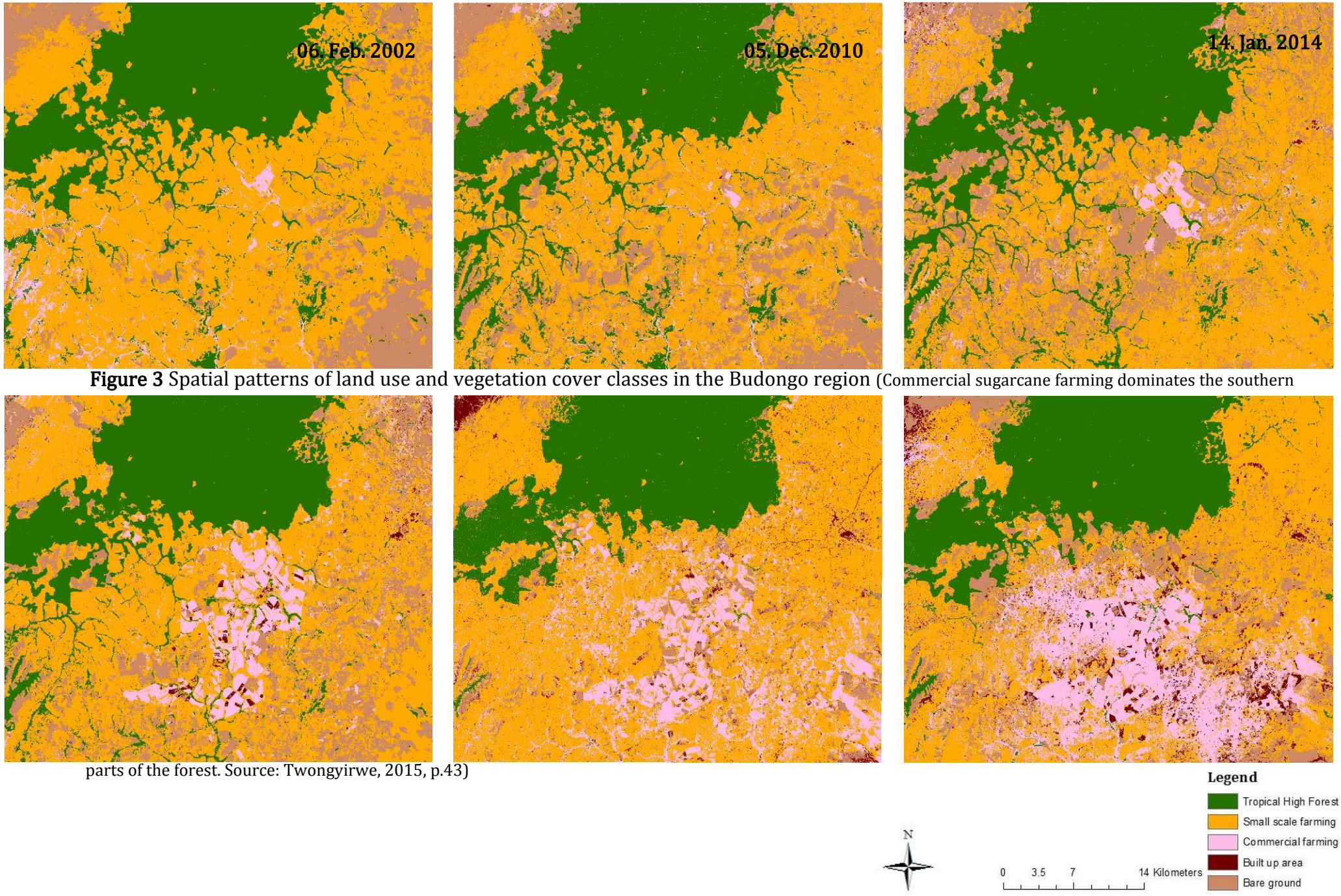

Figure 3 Spatial patterns of land use and vegetation cover classes in the Budongo region (Commercial sugarcane farming dominates the southern parts of the forest. Source: Twongyirwe, 2015, p.43)

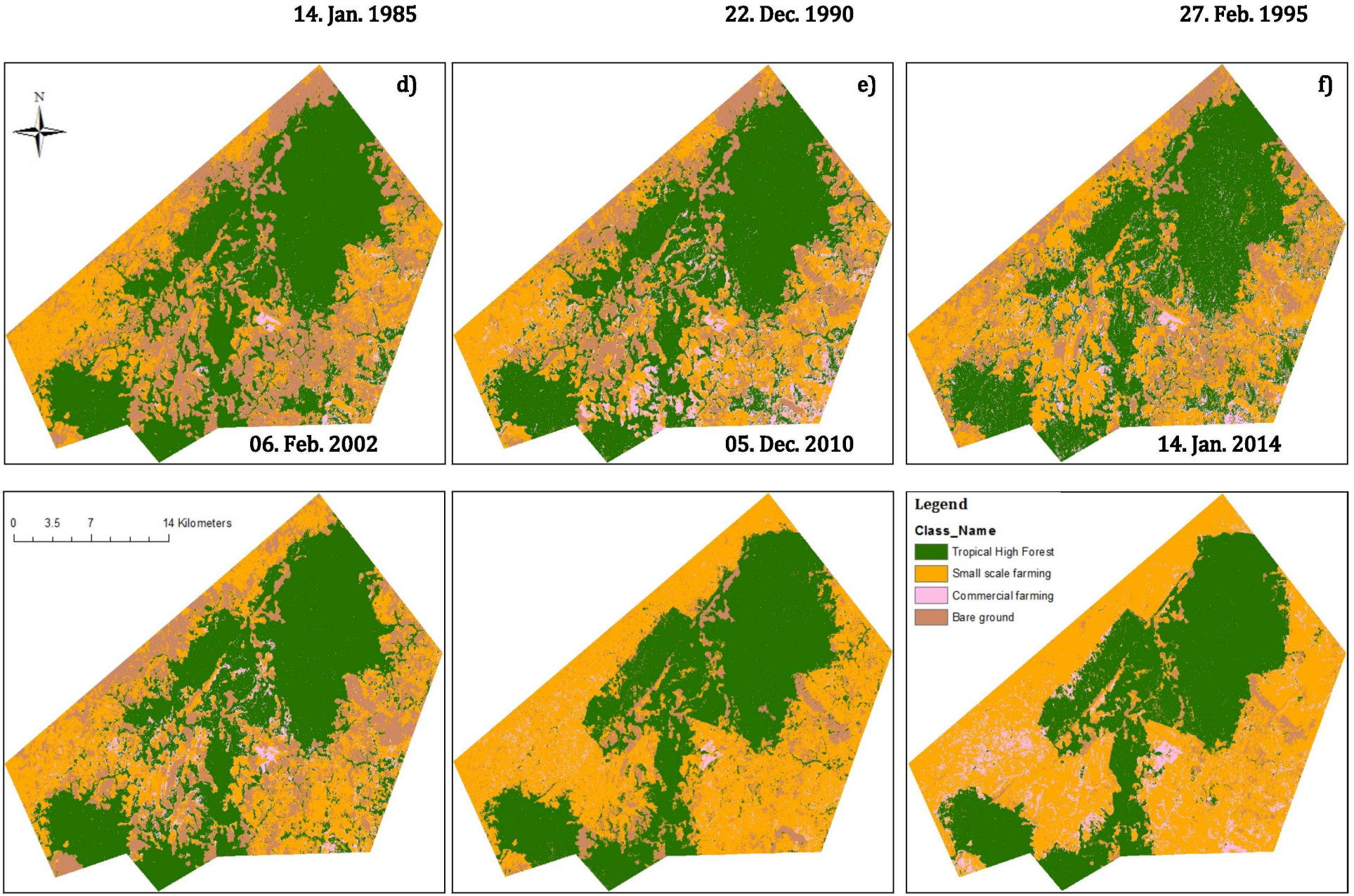

Figure 4 (Small-scale farming dominates the regions surrounding the forest. Commercial farming of tea is also visible but its expansion is limited. Source: Twongyirwe, 2015, p.46)

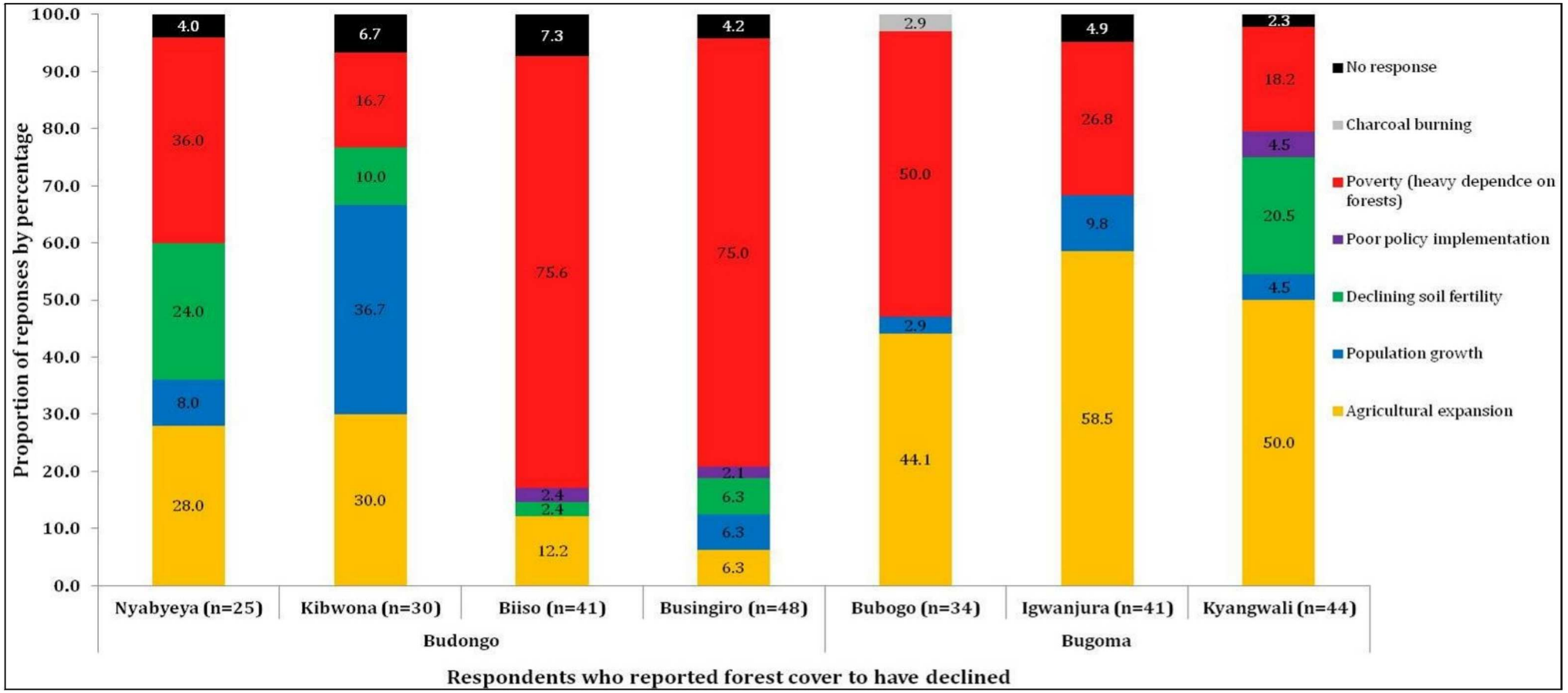

Figure 5 Local perceptions of the drivers of deforestation in parishes around Budongo and Bugoma

Table 1 Number of respondents from each parish around Budongo and Bugoma

Agro-Ecological Zone (AEZ)	Parish	No. of villages in the study parish	No. of respondents	Location (District)
Budongo (n=144)	Nyabyeya	4	25	Masindi
	Kibwona	3	30	Masindi
	Biiso	4	41	Buliisa
	Busingiro	3	48	Buliisa
Bugoma (n=119)	Bubogo	4	34	Hoima
	Igwanjura	2	41	Hoima
	Kyangwali	4	44	Hoima

Table 2 Number of key informants who mentioned the "main themes" on drivers of deforestation around Budongo and Bugoma forests

Theme	No. of key informants who mentioned the theme in relation to Budongo forest	No. of key informants who mentioned the theme in relation to Bugoma forest
Nature of forest cover trend within and outside protected areas	7	3
Agricultural expansion	7	2
Migrants, settlement and population growth	6	7
State of protected forest boundaries	4	1
Poverty and dependence on forests for livelihood	4	0
Management constraints	3	0
Firewood extraction	2	1
Urbanisation	1	0