1. INTRODUCTION

1.1 RECALLING THE PREVAILING PARADIGM

Rwanda's mountainous landscape scenery is unique. Nowhere else along the Great African Rift Valley did the interplay of tectonic forces, volcanic eruption and millions of years of erosive precipitation shape a similar topography. Despite the small size of the country, there is a mosaic of diversified vegetation unlike any other in Africa. It encompasses extensive savanna, cloud forests on steep volcanic slopes, the biggest range of primeval forest in East Africa, papyrus marshes, wide river pastures forming the upper reaches of the White Nile, and small agrarian plots one next to the other across all regions.

1.1.1 Forested landscapes of Rwanda

In films (Townsend, 2010; Liu & Augenstein 2010; Umuhoza, 2018;), in history books (Schoenbrunn, 1998; Newbury, 2009) and in today's scientific literature (Whyss, 2006; Habiyaremye, 2011; Huggins, 2004) one can find descriptions and depictions of a historical forest-covered Green Heart of Africa. Here is a place in equilibrium with nature which is home to numerous different ethnic tribes.

> Large areas of this zone [the Congo-Nile Divide] remained forested until recently, and the very presence of this forest contributed to the conditions of its own preservation. (Newbury, 2009, 287)

"Unlike many other wildlife areas of Africa, these forests [the Virunga Mountains] were probably never previously settled" (Spinoke, 1972, 195). With the population explosion in the 20th century – so the established narrative goes – a fatal degradation of the natural environment began. Large areas of land were cleared of trees causing loss of soil fertility and hydrological function. For a large number of the population already living in hardship, their livelihoods were further exacerbated and became, in the most Malthusian of narratives, one of the main triggers for the 1994 Rwandan genocide. A downward spiral consisting of a lack of arable land and extensive deforestation transformed Rwanda, the "once greenest place in Africa", "where God goes to sleep" after finishing his work, into a tragedy of a singular dimension in history (Sebarenzi, 2009, 103).

Almost universally, the loss of forest cover in Rwanda has been explained by the continuous population growth. With this logic, the inversion of the argument must also be true. With less population pressure on the land, more of the natural landscape should have remained. For decades, forest transition models seemed to

give the scientific underpinning and plausible explanation for the direct correlation between the decrease in natural vegetation and the increase in population density (Meyer & Turner, 1992; López-Carr & Burgdorfer, 2013; Schütze, 2020). The logic of more people – more deforestation, or in reverse, the fewer the people, the more intact the forest cover, has become the lead narrative in describing and framing the landscape history of Rwanda throughout the 20th and 21st century. The introductory sentence of Rwanda's country profile by the United Nations Food and Agriculture Organization is an example:

> Forest resources in Rwanda have steadily decreased over time, especially since the beginning of this century, due to rapid population growth, a limited land base and growing competition for resources. (FAO, 1996, s.p.)

Along the same lines, the United Nations Environment Programme states:

> Rapid deforestation and conversion of natural habitats to agricultural systems has caused a loss in the variability of ecosystems. Biodiversity loss in Rwanda is severe and mainly due to the progressive disappearance of national parks and large-scale habitat destruction. Specifically, natural forests have declined by 78 per cent since 1990. (UNEP, 2005, 3)

Similarly high rates of forest loss are being communicated by development agencies, such as the USAID.

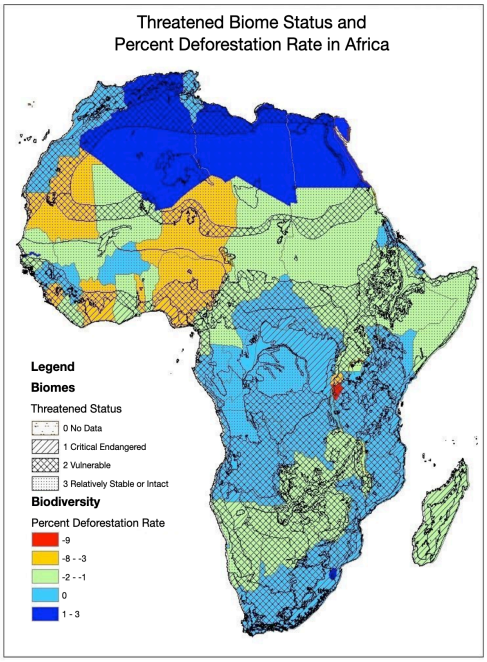
> The present [forest] policy was formulated in 2004, a year after the end of the transitional government. It came into effect after the country had lost two-thirds of the forest estate over four decades. (USAID, 2008, 9)

In a one-sentence formulation, the correlation between demographic pressure and the intact natural environment is often stated as the following:

> Key findings include that Rwanda has lost 60 percent of its natural forest area since independence [1962], driven mainly by the needs of a fast-growing population for land, timber and firewood. (UNEP, 2011c, s.p.)

A broad variety of institutions, with great authoritarian influence in shaping development discourses, seem to communicate a degradation narrative along similar lines.

The findings can also be geo-referenced and expressed in the visual dimensions of cartography. Satellite supported data seem to be able to further verify and detect forest losses. Due to the unavailability of technology before the 1970s, when the first comprehensive earth land-surface cover program, Landsat, was initiated, these



"viscurse"[2] (Knorr-Cetina, 1999, 1) elements helped to spatially localize the narrative. The following continent maps of Africa created by the University of Michigan in 2011 highlight the two neighboring countries of Rwanda and Burundi as the hotspot for deforestation in the center of Africa, far exceeding the forest loss rates in the Congo Basin (Childress, 2010, s.p.). Marked in red and dark orange, no other Central, Southern or East African country is highlighted with forest cover loss of between 3% and 5% on an annual recurring basis.

fig 1.1.1 (Evan Childress, 2010): Rwanda and its southern neighbor Burundi are marked red as the two African countries with highest deforestation rates in Africa.

1.1.2 The apparent logic: more people – more deforestation

The drivers seem to be well understood. It is the need for the wood biomass as timber and fuelwood which has driven the loss in forest cover.

> At a national level, the major agent of environmental degradation is the requirement of wood for different uses including fuel and timber. In excess of 4.5 million cubic meters of wood is exploited each year, up from 3.5 million in 1990. (Huggins, 2004, 301)

This is in addition to the need to make land available for agrarian production and human settlement. With limited knowledge of soil preservation measures, which would have ensured the long-term fertility of fields, a continuous process of slash and burn was utilized in the opening up of new land. With no organized efforts of conservation and spatial intensification, the fatalistic succession of events finds its apparent and cohesive explanation (Mupenzi et al., 2013, 478 ff.).

However, this degradation discourse is not only predominantly led by external institutions and entities since Rwandan scientists also concur. Gabriel Habiyaremye

2 A viscurse refers to the functioning and embedding of visual materials within existing discourses.

provides peer-reviewed evidence of the direct correlation between population growth and deforestation.

> It came out that demographic pressure led to forest clearance and biodiversity disturbances in general. (…) The forest ecosystems, which occupied 30% of the total surface of the country in 1930 has been reduced to 8.9% as by the year 2000. This severe loss of forests has remarkably led to more than 90% decline of fauna species in Akagera National Park. (…) With respect to population connection, the population growth since 1950 is behind the clearing of 80% of rainforests (…) It is noticeable that total area forested in Rwanda was 30% of total land area in the 1930s, reduced to 25.7% in 1960 and finally to 8.9% in 2000. (Habiyaremye et al., 2011, 4533–4538)

Other Rwandan scientists share similar views (Masozera & Alavalapati, 2004; Shabahat, 2020, s.p.)[3] on how land-use changes occurred throughout the 20th century. Nyandwi and Mukashema (2011), from the National University in Huye (NUR) and the Center for GIS and Remote Sensing (CGIS) respectively, validate the correlation: "The change in forest cover in Rwanda is a result of the high growth of population density".

In addition, multiple government institutions, based on figures of the National Institute of Statistics, support the master narrative of deforestation quantitatively in official documentations (Rep. of Rwanda 2003; 2010a; RNRA, 2009; REMA, 2011a; Twagiramungu, 2006).

> Over 64% of Rwanda's forest areas have been lost since 1960. (…) Volcanoes National Park has lost 175 km^2 and Gishwati Forest has been reduced by 97 percent since 1960. In 1997, around 1,085 km^2 of Akagera National Park was also allocated to returnees. (Rep. of Rwanda, 2010c, 4)

> From a historical perspective, we observe that about 70% of the national territory was covered with natural forests but about 60% reduction in the natural forest has also occurred since independence [1962]. (Bizoza, 2012, 16)

According to these official sources, clear cutting of most of the country's land surface took place in the 20th century.

This widely held truth has been extrapolated and even taken one step further. Rwanda's development trajectory serves as a precursor for other African regions with similar exponential growth rates of human population.

> It is easy to accept the obvious, that rapid population growth, land degradation and declining food production are causally linked in a straightforward manner. (Olson et al., 1995, 5)

3 "Natural forests in Rwanda have been reduced to 7% of the total land area from approximately 30% at the beginning of the twentieth century."

While others have stated it less boldly (Bigagaza et al., 2002, 64), they have come to similar conclusions, which have positioned Rwanda as a kind of negative role model for Africa, as its most densely populated country, foreshadowing similar forest loss (and humanitarian tragedies) across the continent.

Viewing the land from this nexus, it seems plausible that the deforestation rates must have been much lower in previous times when fewer people[4] resided on the hills and in the valleys. The majority of the local population could still rely on wild game (Ehret 1998, 123; Grunderbreek & Roche, 2007, 306; Maquet 1957, 77). Rwanda must have been widely forested across the Congo-Nile Divide in the west, the Central Plateau and in the lowlands of the east at the end of the 19th century, with low rates of deforestation and arguably few signs of erosion and soil degradation. All of this was set to change as the population started increasing exponentially, evoking the formula: more people – more deforestation. The currently remaining 7% of natural tree cover (2016) seems to validate this reverse reading of a changing-landscape history (Global Forest Watch, 2014, s.p.; Word Bank, 2016, s.p; intv. 125).[5]

1.1.3 A given path: afforestation made obligatory

In the age of a globally attested environmental crisis, the continuing destruction of the natural environment in Rwanda presents itself as stoppable. With the assistance of additional international financing and by means of restoration and rehabilitation, this destruction can be reversed. All it requires is a general directive from the Rwandan government in Kigali and a participating population in rural areas. The pooling of numerous different ministries and institutes could make pioneering decisions for the revitalization of natural as well as productive landscapes. The imagination of an evergreen forest-covered past led the political goal of restoration efforts towards 30% forest cover by the year 2020, a target which was already reached in 2019, according to state media outlets (Nkurunziza, 2019).

With the recent widespread loss of forest cover, the government of Rwanda is determined to restore regulatory and supportive functions of the once standing biomass on a countrywide scale. As a result, a set of far-reaching policy interventions has been formulated and institutional adjustments have been undertaken during the first decade of the 21st century (World Future Council, 2016). Together, they form the governance framework for a state-led rehabilitation and restoration strategy addressing a diverse set of ecosystems, which include riverbanks and wetlands (Ch.

4 Chrétien (2006, 473) estimates that in the area that forms present-day Rwanda more than about 1.5 million people created a population density of about 58 people per km2 100 years ago. Strizek (2006, 45) shares a similar perspective: "Rwanda, in comparison to neighboring Uganda, has been densely populated with about 1.5 to 2 million people at the end of the 19th century already."

5 With an additional 12% of newly planted forest plantations, totaling at 30% forest cover in 2020.

2.2, 2.5), coastal zones along the lakeshores (Ch. 2.2), vegetative buffers along the city peripheries (Ch. 2.6), agrarian fields (Ch. 2.1, 2.3), forest reserves (Ch. 2.8) as well as national parks (Ch. 2.4, 2.7). Instrumental to all interventions are memories of widespread densely forested landscapes and the prevailing narrative of massive deforestation throughout the previous century. This led to the political objective of achieving 30% countrywide forest cover and 85% agroforestry within the areas under cultivation (Rep. of Rwanda, 2000, 2003, 2010a; Rutabingwa, intv. 125).

Under the environmental governance framework of the National Environmental Policy and the Organic Laws on the Environment, which is part of the overarching multi-year strategic development plan called the Economic Development and Poverty Reduction Strategy (EDPRS I & II) (2008–2012 / 2013–2018), these far-ranging decisions on forest cover increase have been made and cemented under the National Strategy for Transformation (2017–2024). This included a profound restructuring of state institutions as well as the stipulation of additional ones[6] in the post-conflict era. Currently, the key institutional stakeholders commissioned to assist in the implementation of national restoration strategies are: the Rwandan Environment Management Authority (REMA), the National Land Center (NLC), the Rwandan National Resource Authority (RNRA), all subsumed under the Ministry of Natural Resources (MINERA), as well as the Ministry for Agricultural and Animal Resources (MINAGRI) and the Rwandan Development Board (RDB), which includes the Rwandan Office of Tourism and National Parks (ORTPN) (UNEP, 2011b, 304). They have jointly drafted a Five-Year Strategic Plan for the Environment and Natural Resources Sector 2014–2018 (MINIRENA, 2013), a National Strategy and Action Plan for the conservation of biodiversity in Rwanda (MINIRENA, 2003), as well as an annual Strategic Plan for the Forestry Sector (RNRA, 2016), all to be implemented before 2020, in order to bring about the 30% forest cover.

1.1.4 Progressive erosion: a narrative loses ground

While there is debate surrounding the broader policy frameworks and practices in the post-conflict setting (Strauss & Waldorf, 2011; Pottier, 2002; Zorbas, 2011), the enactment of effective legislation surrounding environmental governance is not only recognized by those international bodies with stakes within the system (UNEP, 2011a, s.p.[7]; 2011b, 310[8]; World Bank, 2014b), but also by more independent institutions and individual authors (Aronson, 2013, 3; Chabay et al., 2015). However,

6 FONERWA (Fonds National de l'Environnement au Rwanda), Rwanda National Environment Fund (UNEPb, 2011, 304; FONERWA, 2016).

7 "Rwanda provides an exceptional case of a country's willpower to overcome a traumatic conflict legacy, restore degraded ecosystems and lift people out of poverty and there is growing interest from development partners and other countries in Rwanda's pioneering model."

8 "Rwanda is moving towards developing one of the most effective environmental governance regimes in Africa."

along with the acknowledgment of high operational effectiveness comes the almost universal description of a centrally controlled, top-down governance approach, which leaves ascertainable room for improvement, especially in the context of participation, decentralization and implementation (Ansoms, 2008; Booth, 2012; Hahirwa, 2012; Huggins, 2013). The increasing territorial divide between the urbanite political elite and the majority of the 80% peasantry in rural areas (IFAD, 2014, 1) seems to be a historical constant, regardless of the political constellation (Ansoms, 2009). As is currently the situation under the Paul Kagame-led one-party system of the Rwandan Patriotic Front (RPF), focal restoration (Higgs, 2003, 225–259) is not given first priority.

1.1.5 A broken frame: the deconstruction of established imaginations

Despite shortcomings, Rwanda has a remarkably long-term vision and notable ambition to restore all of the country's critical ecosystem functions in a border-to-border endeavor, within a time period of less than 25 years (Mukankomeje, former DR REMA, intv. 114). This academic research was meant to assist this process with the compiling of evidence about the natural vegetation cover and its appearance in the pre-colonial landscape of Rwanda. Having worked over multiple years on various assignments for the Rwandan Environment Management Authority as a producer and cameraman, this opened up the opportunity to see all corners of the compact country through the viewfinders of various cameras.

The original – yet soon-to-be-discarded – aim of this academic research was to find illustrations and descriptions of the vegetative composition and structure of the historical landscape. This was intended to provide deeper insight into the distribution of the native and indigenous plants that would benefit the ongoing nationwide reforestation and perma-cultivation efforts. Early documents, consisting of historic photographs, expedition reports and cartographical relics from the onset of colonialism should have provided a view which is a little distorted and with moderately influenced habitat conditions of many individual biomes. These documents should also have been able to provide insight into the compositional arrangements of plant communities across the Rwandan landscape right before the onset of the large-scale deforestation that was to affect vast stretches of untouched territories.

Meant as complementary bio-geographical research with special emphasis on the exact distribution of known plant types, initially this scientific investigation focused on the spatial dimensions of flora diversity. Until then, the closest approximation on a geo-referential dispersion of plant communities had been done through the country's herbarium in Huye, former Butare,[9] as part of the Institute of Scientific and Technological Research, in a set of jointly published potential vegetation maps starting with Troupin in 1978, Prioul & Sirven 1981, to the latest by Lillesø

9 Personal communication with Védaste, Minani, National Herbarium of Rwanda (intv. 113).

et al. from the year 2011. Earlier works,[10] in much lower spatial resolution, include the writings of Gottfried Mildbraed (1907) and landscape surveyors from the Belgian[11] period of 1955 (Rushemuka et al., 2014, 142). The spatial resolution remained at scales smaller than 1:25,000, leaving heterogeneous vegetation units with broad delineation of ecozones.[12] Vegetative boundaries strongly followed an altitudinal layering. As a result, a precise understanding of the phenomenological articulations of plant composition prior to increased human impact and deforestation could not be derived. Today's publications with landscape references on historic biome expansions primarily utilize photographs of existing ecosystem complexes to illustrate by means of derivation (Lillesø et al., 2011; Védaste, 2012). This 1:1 spatial extrapolation remains strongly tied to a linear-climax modeling of ecosystem conditions, which will be controversially discussed in a more detailed manner within the following theory section. The earliest historic photographs should give insight and be a door opener to a long-gone past, consisting of pristine and semi-intact ecosystem conditions across large portions of Rwanda's landscape at the beginning of the age of colonialism.

1.1.6 What I see is no more: reconstructing landscape fragments

At an early stage, however, it did become clear that the established current descriptions of the historic landscape in Rwanda could only be construed in a limited manner. The earliest visual evidence (1885–1916) on historic landscape conditions told a quite different story. These first eyewitness recordings on paper or glass plates from photography trigger a process that will eventually lead to the progressive reframing of existing landscape memories[13].

img. 1.1.1–1.1.3 (GCS, 1907/1912): Treeless landscapes on the Central Plateau in Rwanda.

10 Historically, the mapping unit's main purpose was to assist strategic agricultural, forestry or conservation planning rather than the restoration of once existing compositions. Agro-ecological zoning dates back to the 1930s (cf. Lillesø, 2011, 3–8).

11 As part of the Institut National d'Études Agronomiques au Congo (INEAC), which also had Rwanda within its research mandate.

12 For a broad overview of vegetation mapping throughout Eastern Africa, including Rwanda, see Lillesø, 2011.

13 Cf. based on the German term "Landschaftserinnerungen" / see also Matthew Stadler's novel Landscape: Memory (1990).

Apart from the vast visual archive – consisting of 445 historic photographs across Rwanda, most of them digitized for this research for the first time – there is also a set of written accounts originating from travel diaries, expedition journals and science publications of the time, which once more are viable sources, helping to destabilize the existing hegemonic narrative.

Furthermore, the dominant narrative of forest cover loss can also be challenged by the historic cartographic artifacts that cover the country border to border. They are precious source materials that help differentiate and create unease with the existing narrative. More than 20 maps, most of them also digitized for the first time for the purpose of this research, give insight and approximations on how the vegetative cover and settlement structures were interwoven at the time. Under critical consideration of preciseness, accuracy and scale (Lukas, 2014; Nell, 2009), these early maps hold additional information on where semi-undisturbed gallery forests might have been located more than 100 years ago.

Hence, the explanatory shortcomings of the original purely bio-geographical research design became apparent. Based upon the newly surfaced twofold difference between the state of ecosystem conditions of the past and the current practices of remembering and representing, these historic references required a correctional shift in the research design. Theorems from political ecology and critical human geography substituted the former approach. From a critical research perspective that centers around political ecology, a more fundamental questioning could be made about the unearthed diverging depictions and constructed memories. Repeat photography emerged as the most adequate empirical methodology to (a) find certainty about the actual position of the historic barren landscape depiction, and (b) to see how a dialectic between the past and the present could create a beneficial momentum for present-day landscape restoration policies.

By looking at present-day landscape configurations from a vantage point of 100 years past, how does it amend those established trajectories that had been constructed mostly in reverse? What can be learned about the mechanisms of prevailing degradation narratives? What kind of renewed reading of Rwanda's landscape transitions emerge through the insight of large-scale deforestation, long before the demographic growth of the 20th century? Finally, what are the effects of shifting reminiscences of landscape baseline conditions for present-day negotiations on restoration efforts? In other words: what kind of gains could be derived from reconstructed memories for the reframing of current practices of ecosystem restoration?

The objective of this study is the deconstruction of the prevailing paradigm of forest regression and the creation of a counternarrative that provide a radical new reading of the landscape transformation in 20th century Rwanda. Supported by visual evidence from 64 re-photographed and geo-referenced viewsheds,[14] this in-depth examination tries to carefully reframe an alternative landscape trajectory. In

14 A viewshed is the environment that is visible from one particular viewing point (Oxford Dictionary, 2016), a term likely coined and first used by Clifford Tandy (1967) in the context of landscape surveys.

addition to the site-specific primary anchor points of repeat photography, historic diaries, maps, science articles and almost 100 interviews with village elders living in proximity of, or even within, the re-photographed viewsheds themselves contribute to this analysis. These voices of ordinary farmers, which have often been suppressed throughout most of the 20th century, be it through discoursive constraints or scientific methodology, help verify and extend new landscape perspectives. And perhaps, from a more differentiated and detailed understanding, the need emerges to question basic models by Kuznets (1955; cf. Culas, 2007) or Malthus (1798), which have advanced the axioms of landscape change science, leading perhaps to their partial reconfiguration or, as in the case of Rwanda, to a complete rejection.

1.1.7 Suppressed memories or amnesia: on the limitation of insight

Arguably, being the first political ecological study to work on ecosystem restoration conflict lines in Rwanda while trying to reframe a dominating deforestation narrative, it seems crucial to reflect on why the paradigm of densely forested landscapes would circulate for so long in present-day discourses. Their very existence and their persistence are arguably rooted in an identifiable set of causes. Front and center are purely technical constraints of information accessibility, paralleled by discoursive factors of political-economic dimensions that operate with visible rules of exclusion and extrapolation, as well as perspective limitations deriving from methodologies utilized within ecology and history.

Technical constraints: visual capital and the administration of estates

Primal is the inaccessibility of various sources (Scholte, 2011), which determined much of the previous research findings. The historic image archives of the German Colonial Society (Deutsche Kolonialgesellschaft, Frankfurt), the Protestant Missionary Society (Evangelische Missionarsgemeinschaft, Wuppertal), the White Fathers (Patres Albi, Rom), the Royal Museum for Central Africa (Musée Royal de l'Afrique Centrale, Tervuren, Belgium) as well as the Ethnographic Museum of Rwanda (Huye) have, for the most part, not yet been digitized and made freely available to an interested public or scientific researchers. This visual analysis of historical landscape conditions is the first of its kind, only preceded by an unfinished monograph by a Belgian scientist, who died before the work could be finalized and published.

Likewise, none of the earliest detailed reports (Baumann, 1894; Czekanowski, 1917; Johansen, 1915; Kandt, 1904; Meyer, 1909; Mildbraed, 1908) on expeditions throughout Rwanda in the 19th and early 20th century – originally written in German – have been translated into the local language Kinyarwanda, nor into the primary science language of English, nor into the administrative language of French used during half a century of Belgian colonization. The only exception is a popularized monograph by Duke Mecklenburg (1909) under the original title “Ins