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Ecologies of the colonial present: Pathological forestry from the *taux de boisement* to civilized plantations

Diana K Davis
University of California, Davis, USA

Paul Robbins
University of Wisconsin, Madison, USA

Abstract

Tree-planting has long been an obsession of postcolonial environmental governance. Never innocent of its imperial history, the practice persists in global regimes of forestry today. For over two centuries, afforestation has been viewed as a panacea for a variety of ills including civilizational decline, diminished precipitation, warming temperatures, soil erosion, and decreasing biodiversity. As a result, tree plantations, despite their demonstrated failings in many environments, have flourished as an art of environmental governance that we term arboreal biopolitics. We trace some of the origins and importance of the *taux de boisement* in such plantation efforts, typically understood as a percentage of "appropriately" wooded land within a territory. Likely first developed in France by the early 19th century, this notion was operationalized in colonial territories assumed to be massively deforested. Targets of 30–33% forest cover, the minimum assumed for European civilization, were built into French forest training and policy and exported globally. Indeed, we demonstrate here that these French colonial policies and influences were as significant in many regions as those of better documented German forestry traditions, especially in African colonial territories and in British India. We further analyze the implications of these policies, and the degree to which the concept of a *taux de boisement* appears to have traveled to colonial forestry in India, further shaping forest policies of the postindependence era. We provide the example of the "National Mission for a Green India," an effort by the Government of India to increase forest/tree cover by 5 million hectares and improve quality of forest cover on another 5 million hectares of forest/nonforest lands. Ostensibly aimed at improving forest-based livelihoods, the initiative has all the qualities of past forestry efforts in India, which have historically performed a reverse role: disinheriting forest-rooted populations. Colonial forestry, we therefore conclude, continues to haunt contemporary policy, contributing pathological ecologies, especially in the drylands, often with pernicious effects on local people.

Corresponding author:
Diana K Davis, Department of History, University of California, Davis, 1 Shields Ave., Davis, CA 95616, USA.
Email: geovet@ucdavis.edu

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Introduction

In July 2016, some 800,000 volunteers in the state of Uttar Pradesh, India, planted a total of 49.3 million saplings winning a world record in tree-planting. This effort advanced India's commitment to spend $6 billion to reforest 12% of its land, with the ultimate goal of 235 million acres under trees by 2030; that would represent about 29% of the country's total land cover (Howard, 2016).[1] Leaving aside the likelihood that a vast majority of these trees will die, and that the productive labor time of these rural volunteers might have been directed to activities that more directly supported their livelihoods, a puzzle remains: why does tree-planting have such a fix on the official imagination of India?

This effort is part of the National Mission for a Green India, a 7 billion dollar environmental intervention laid out in 2011 by the Government of India, which seeks to put a third of that country under forest cover. Ostensibly aimed at ameliorating climate change and providing livelihoods, the policy represents an ambitious effort to totally transform the landscapes of India. Notably, however, the policy follows decades of failed, plantation-focused, forestry efforts by the Indian government, which frequently have been shown to interfere with local economies and ecologies, lead to undesirable species invasions, and advance the power of the State Forest Departments at the expense of pastoral and tribal communities (Balooni and Singh, 2007; Joshi et al., 2011; Robbins, 2001b). Why is the National Mission for a Green India built upon demonstrably problematic and ineffective elements of environmental and social policy?

We argue here that the policy rudiments of the National Mission do not stray far from most forest policies implemented in India since its independence and reflect the momentum of a consistent, arborocentric, and target-driven approach to land management. This approach, though emerging in official Indian policy near the end of the British colonial era, appears to have its roots in French colonial forestry and that tradition's deep commitment to the "*taux de boisement*"—a rate of woodedness.

National Mission for a Green India

Amidst global concerns about climate change, the Government of India announced its National Action Plan on Climate Change in 2008. The National Mission for a Green India is one of eight missions under that plan. The Prime Minister's Council on Climate Change approved the National Mission in February 2011 (Government of India, Ministry of Environment and Forests, 2011), with an estimated mission cost of Rs. 46,000 crores (a little more than 7 billion dollars). The main mission objectives are to increase forest/ tree cover on 5 million hectares (mha), and improve the quality of forest cover on another 5 mha of forest/ nonforest lands, for a total of 10 mha. Other objectives include improved ecosystem health and services (biodiversity, hydrological services, carbon sequestration, etc.), increasing forest-based livelihood income of three million households living in and around forests and enhancing annual CO_2 sequestration by 50–60 million tonnes in the year 2022.

These objectives are further broken down into specific targets where the improvement in forests will happen. These include 5 mha of forests/nonforests, including moderately dense, open forests, "degraded" grassland and wetlands; 1.8 mha of scrub, shifting cultivation

areas, cold deserts, mangroves, ravines, and abandoned mining areas; 0.2 mha of urban/peri-urban lands; 3 mha of marginal agricultural lands/fallows and other nonforest lands under agroforestry/ social forestry. Public forests/nonforest areas are to be managed by community institutions mandated by the Gram Sabha, an arm of autonomous local government, at the village level.

Chief among all these details, however, is the overarching narrative power of the plan and its ambition to increase/ improve forest cover over 10 mha total. If it were to be accomplished, that would bring close to one-third of India under forest cover (Joshi et al., 2011). This would represent a major landscape intervention, since forests cover only 21.34% (70.17 million ha) of the geographical area of India today (FSI, 2015).[2]

Pathologies of afforestation

This approach to forestry in India has been fraught with countless, commonly observed problems. First among these is the problem of quantified targets themselves. As Joshi et al. (2011) have documented, a commitment to fixed rates of forest cover encourages tree plantations in ecologically inappropriate sites and conditions. In the process, they note as well, this fixed rate discounts and overrides other nontree ecosystems and land covers, like grasslands, mixed scrub, alpine, and riparian habitats.

It has also been extensively documented that afforestation on lands outside of government control, typically occurs in areas identified as "wasteland" under revenue census but which are typically under extensive use as local grazing commons, areas for nontimber resource collection, or water catchments (Balooni, 2003; Balooni and Singh, 2003, 2007; Government of India, Ministry of Environment and Forests, 1990). Afforestation typically extends the authority of Indian state forest departments, in this way, at the expense of local livelihoods, rather than in support of them (Brara, 1992).

The problems of plantation ecologies in India are also well documented. An enthusiasm for fast growing species and exotic and invasive species, planted in the name of increasing land cover dedicated to "forest," is a constant problem in Indian forestry (Robbins, 2001a, 2001b, 2005; Saxena, 1992). Enthusiastic foresters, whose central objective is to encourage afforestation in the region, have long favored invasives, such as *Prosopis juliflora* (honey mesquite, known in India as Angrezi Babul), that tend to drive out local forage grasses and compete with indigenous and endemic tree species. As one forest officer explained of plantations in India: "When you look at a picture of the area from the air, you see *thirty percent of the land in forest*." "Without the Angrezi Babul tree, you would find no forest at all. The tree does our work" (Robbins, 2000: 138, our emphasis). Even after such invasive species have been abandoned, the logic of speed of growth and extent of coverage remains.

Aggressive afforestation projects in India also tend to draw attention to, and direct resources toward, tree-planting, without a concomitant commitment to addressing the drivers of widespread and large-scale deforestation. Such impacts are especially acute from mining, as well as from industrialization and mega infrastructure projects (Meiyappan et al., 2017). These disruptions occur despite environmental laws regulating extraction and calling for impact assessments (Bedi, 2013). Neither are such impacts typically remediated by afforestation.

The National Mission also appears to run athwart recent efforts to extend land rights to politically disenfranchised communities. Specifically, Adivasi tribal groups, who have historically been forest dwelling or forest adjacent, were only recently granted greater control over their lands under the Forest Rights Act of 2006 (Kumar et al., 2015; Ministry of Law and Justice, 2007). Under that act, their ability to manage lands, cut

trees, farm, or graze was expanded where they could show continuous historical settlement. The ambitions of the National Mission, to overwrite local land uses with tree production, stand a good chance of colliding with the rights of such local communities.

It remains entirely unclear, moreover, whether large-scale plantations have positive effects on socioeconomic conditions of communities. A recent systematic review (Malkamäkia et al., 2018) suggests that, on balance, such efforts have significant *negative* impacts on local communities in terms of employment, livelihoods, and other "intertwined" social impacts. India's new Compensatory Afforestation Fund Act, passed in 2016, which legislates that if forest is cleared an equivalent amount of land must be afforested elsewhere, is likely to further undermine local control of land and extend the reach of the Forest Department to the detriment of local livelihoods (Kodiveri and Karthik, 2018).

None of these problems are unique to Indian afforestation. Indeed, they are consistent with a global habit of arborocentrism, plantation economics, and Imperial and postcolonial forestry. Such obsessions with tree-planting are typically linked to fairly narrow utilitarian regimes and specific industrial interests, all shrouded in what anthropologist Tania Li (2007) would call, "the will to improve." That is to say, the way the problem is frequently framed as one of deforestation (Li's problematization), shapes the possible solutions for improvement as those of afforestation (Li's rendering technical), which in reality likely benefit larger state and industrial interests.

These also sit within a larger policy program. As has been noted recently, practices of tree plantation have become a part of a larger commitment to ameliorating "desertification," a purported, human-caused decline in the productivity of arid and semiarid lands around the globe. Here, areas that have been deserts since long before their human occupation are identified by colonial, state, or government authorities has having been degraded by people, justifying large-scale tree plantation, often in areas that are sensitive to, and further degraded by, such interventions (Davis, 2016). Such was the case in the war on desertification throughout Saharan Africa in the 1970s, which led to interventions that clearly empowered state technical authorities, typically at the expense of local communities especially pastoralists and nomadic herders (Davis, 2016; Mortimore, 2009).

This is not to argue that trees and the planting of trees may not be a critically important part of a suite of strategies for poverty alleviation, resource development, carbon sequestration, and local empowerment in some environments (Meaza and Demssie, 2015; Nibbering, 1999). It is also frequently the case that afforestation of historically unforested lands has greater negative impacts than reforesting recently denuded landscapes (Veldman et al., 2015a). Even so, national forest targets, within the context of complex political economies of land cover and land control, are often highly problematic. Moreover, in the face of mounting emissions from fossil-fuel heavy energy generation in India (well more than half from coal), a focus on forestry rather than widespread energy transition seems misguided.

Given these mixed results, especially in the Indian context, it is reasonable to ask how this idea developed. As it turns out, the Green Mission, and especially its enthusiasm for targets, afforestation, and extending forest department authority and influence over nongovernment lands, is one that is consistent with, and differs very little from, previous Indian forest policy.

The deep roots of afforestation/reforestation

In most recent history, the National Forest Policy of 1988 is strikingly similar to today's National Mission. Notably, the 1988 Act sets a 33% forest cover target and lays out goals

for plantation and the recovery of "waste" lands (i.e. grazing commons and other "underutilized" community resources). This Act does not justify its efforts by addressing climate change, but instead by improving local livelihoods. Even so, its rudiments and its commitment to an arbitrary one-third goal are essentially the same.

Neither was this idea new in the 1980s, as that afforestation mission was presaged by the National Forest Policy of 1952, which also calls for a third of India to be converted to forest. This 1952 Policy derives its arbitrary quantitative target, according to Joshi et al. (2011), via a survey conducted of the woodedness of other countries of the world. In the background paper to the Policy, it is pointed out that North America had 33% cover and Europe 41%, while North Africa had 22% and South and East Asia had 23%, a simplistically comparative methodology with a deep and problematic history. The general prosperity of a region, the Policy's authors concluded, ran parallel to the proportion of its forest cover. The Policy was consistent with the earliest expressions of development ambition in the young Indian State. The First Minister for Food and Agriculture, K. M. Munshi (1952) lauded what he called "The Gospel of the Dirty Hand," praising tree-planting along with agricultural intensification, borewell drilling, and the creation of Rural Development Boards, all harmonious with national interests.

Nor did this Policy occur in a vacuum. During the early postcolonial period, and on through the 1970s, international development aid to India was funneled into forestry, agroforestry, and afforestation, with participation of the World Bank, the Food and Agriculture Organization of the United Nations, and others. Such efforts would be followed by a slew of more contemporary Indian state efforts for land management stressing tree plantation, including the creation of the National Wastelands Development Board, the National Afforestation Eco-Development Board, and the National Tree Growers Cooperative Federation Limited. Echoing Munshi's passion for forestry, in his inaugural speech Rajiv Gandhi (sixth Prime Minister of India: 1984–1989) called for the afforestation of 5 mha of "wastelands" every year (India Today, 1991).

While the 1952 policy is the first official Indian forest policy to stress such targets for afforestation, and to set a one-third goal, the notion of an appropriate rate of woodedness actually has even earlier precedents. Written in 1944, while the war in Asia raged, Sir Herbert Howard's proposed postwar forest policy suggests targets and methods for afforestation on a grand scale in India. Then the Inspector-General for Forests for India, Howard (1944) offered his policy to repair the 1894 Forest Policy[3] in India, which he complained "nowhere lays down the percentage of the country which should be under forest" (2).[4]

Insisting that the current cover of roughly 14% was inadequate and of poor timber quality, and that "many individual provinces have less forest land than ordinarily be considered necessary," he advocated plantation of trees toward quantified targets (Howard, 1944: 2). Specifically, he concluded that "taking an average of European countries, it appears that 25% of the area is the normal ordinary area of forest" (Howard, 1944: 2). As a result, something close to that level of cover was desirable for all of India, with coverage distributed evenly over the provinces. To hit that target, Howard recommended bringing more government wastelands under forest, bringing more private area under forest, and taking legal control of private forests. It does not have to be pointed out that these approaches are startlingly similar to those advocated in the 2011 Green Mission.

Sir Howard's policy was never implemented in the postwar period, owing to disruptions associated with the transfer of power during Indian independence in 1947. Even so, the reformed Forest Department of the new nation emerged from British rule largely identical

in structure, goals, and organization to its colonial predecessor. As Gadgil and Guha (1993) confirm, the postindependence Forest Department closely mirrored its predecessor. It increased its domain, however, by expanding its portfolio to include forest-based industries and further tree-planting.

The 1952 Forest Policy, therefore, unsurprisingly adopted a focus on afforestation targets, expressed as percentages of total land cover, for recovering "waste" lands, and extending tree cover on nongovernment lands, including villages and the property of farmers and smallholders. The elements of early independence afforestation policy are nearly the same as those of the National Mission for a Green India and are rooted in the habits of late colonial forestry.

Sir Howard's policy recommendations were themselves presaged by the recommendations of Indian foresters for the creation of an afforestation branch of Indian forestry, as early as 1909. Here the boldest suggestion was that all waste lands under the control of the government be given over to this afforestation division (Anon, 1909). By 1939, a board for afforestation was proposed, only a few short years prior to Howard's policy (Anon, 1939). The natural conclusion from all this might be, therefore, that afforestation enthusiasm was imported to India from Britain. It would seem, however, that this was not the case.

Forestry from India to Britain

For most of its colonial history, Britain relied heavily on the import of timber from its colonial holdings for the manufacture of its naval fleet, its railway sleepers, and other timber needs. The development of forestry as a science in Britain, therefore, was largely focused on extracting and processing trees. The first proposals for afforestation in Britain were published in the *Manual of Forestry* in 1889 by the German forester William Schlich (1889: 57–67). Schlich, who had been serving in India since 1866, most recently as the Inspector-General of forests to the Government of India (1881–1885), published this multivolume manual while serving as director of forestry at the Royal Indian Engineering College at Cooper's Hill, England.[5]

His call for afforestation in England and Ireland (for primarily economic reasons) was quickly taken up and repeated in the pages of the oldest journal on tropical forestry: *The Indian Forester*. The journal was first established in 1875, under the editorship of Schlich. In the pages of this journal, in 1894, two articles appeared advocating Schlich's call for the afforestation of England and Ireland (Anon, 1894; Fisher, 1894). In 1909, Sir Herbert Maxwell repeated this idea in the *Indian Forester* by stressing the declining quality and cover of forests in Britain and the vulnerability of the nation to timber import dependence. Pointing to the industry's ability to absorb surplus Irish labor and produce export income, Maxwell (1909) called for a "great undertaking" in what he called "National Afforestation" (712).

This call followed two others in the year prior, both in the pages of the *Indian Forester*, for the afforestation of Scotland and of Ireland.[6] It was followed by prodding for afforestation in New Zealand (1928), Palestine (1929), and Wales (1929).[7] *The Indian Forester*, thus, became a professional platform for afforestation zeal across the British Empire. Indian afforestation paralleled and became the training ground, in this sense, for other imperial experiments, rather than the destination for already-developed environmental policies.[8]

So if Indian afforestation enthusiasm is not a product of British management traditions (indeed it would seem almost the reverse), from where does the logic of the Green Mission originally come?

The *taux de boisement*

In his 1893 poem, "In the Rukh," Rudyard Kipling (1895) waxes romantically about the Indian forester. He writes:

> of the wheels of public service that turn under the Indian Government, there is none more important than the Department of Woods and Forests. The Reboisement (reforestation) of all India is in its hands …. Its servants wrestle with wandering sand-torrents and shifting dunes … pegging them down (atop) with coarse grass and spindling pine after the rules of Nancy.

In this opening passage, we are given a glimpse into the deeper roots of the afforestation drive. On the one hand, reboisement (reforestation) is clearly among the most widely known goals of Indian forestry.[9] Here, the forester performs a ritual of sand dune control through the plantation of wattle (thorn trees) that would be familiar to any Indian forester, even today. Kipling also reveals in the poem the heavy dependence of Indian foresters on training in France. Beyond invoking the French term for reforestation (reboisement), references here are made to the "rules of Nancy," those forestry practices learned at France's national forestry school in Nancy, France.

In fact, a great many British foresters in India were trained at the French national forestry school in Nancy in the late 19th century. Founded in 1824, this was, and remains, one of the elite forestry schools of Europe and attracted students from many parts of the world.[10] In the quarter century between 1867 and 1893, about 84 of the roughly 95 (88%) British foresters sent to India were trained in France, and during the decade from 1875 to 1884, British foresters were trained exclusively in France and no longer in German schools (Guyot, 1898: 192–193; Ribbentrop, 1900, 227–228).[11] From 1873 to 1884, these British students were overseen by Colonel George Falconer Pearson, a British forester with many years' experience in India (Anon, 1923; Guyot, 1898; Lionnet, 1986: 59).[12] This helps to explain, in part, why the majority of British foresters in India paid close attention to, and were strongly influenced by, French forestry traditions.[13]

One of the most important of these traditions was the centrality of the *taux de boisement*. This is the concept of a percent forest cover, a rate of forestation, or a coefficient of woodedness of any given country or territory. It was calculated from the late 18th century in Europe—primarily in economic calculations regarding the timber and wood supply of European countries. By 1900, however, as detailed below, it had been refined as the *taux de boisement normal*, the normal ("proper") rate of about 30–33% forest cover that was believed necessary to support "civilization" by regulating the climate and rainfall in the "hot" countries. The ultimate goal was to make both colonized people and the environment more European, since Europe was the alleged center of civilization. Although developed and refined in France and colonial Algeria, the concept of the *taux de boisement*, and the attendant afforestation policies to attain the proper *taux*, became widespread in many parts of the world by the mid-20th century (Guillard, 2014). In India it has had a particularly long-lasting and widespread impact.

India's third Inspector-General of Forests, for instance, the German Berthold Ribbentrop, noted in 1900 during an extensive lamentation of the massive deforestation of India and its disastrous consequences of aridification, loss of fertility, and decline of civilizations that about 90% of India could and should be forested. Barring that, he calculated that if "30% of the country was under complete forest, the rainfall throughout [the territory] should increase by 10%" which he judged enough to remedy the historical damage done by centuries of deforestation (Ribbentrop, 1900: 45, 48). Attaining 30% forest cover was for him a crucial goal.

By stating his goal of reforesting India to 30% forest cover, Ribbentrop was invoking the by then well-known French notion of the *taux de boisement normal* of about 30%. Although trained in a German forestry school, Ribbentrop (1900) knew, and was clearly influenced by, much of the French literature on forests, rain, and desiccation as is evident from the many French citations in his notable book *Forestry in British India*. Ribbentrop was certainly not alone in being influenced by French forest theory and practice. From its first published volume, the widely read journal *The Indian Forester* spilled much ink translating and reprinting many articles from French forestry journals and monographs. Nearly every issue for the last quarter of the 19th century contained one or more articles on French forestry or by a French author. New French forestry books were noted, reviewed, and usually strongly recommended.[14]

British interest in French forestry and related subjects predates *The Indian Forester*, however. From at least the 1840s, British intellectuals and professionals including doctors and scientists were closely following, and being influenced by, French theories of deforestation and desiccation and the concomitant need for reforestation, especially in hot, dry territories. The powerful British surgeon Edward Balfour (1849), for example, knew and read most of the primary French authors in the development of desiccation theory and strongly advocated afforestation for India.[15]

Before the *taux de boisement*: Deforestation, desiccation, and survival

The importance of French thinking and action on the topics of forestry, deforestation, desiccation, and climate amelioration by reforestation, however, has not been recognized by many scholars. Despite not being widely acknowledged in the recent literature, this is an important component of the history of forestry that complements the more widely known view that Germany pioneered the science of sylviculture, or how to grow the greatest number of the ''right'' kind of trees quickly and thus make efficient the process of timber production and revenue generation. In the words of the influential German forestry scientist, Franz Heske (1938), though, ''to the French belongs the credit for having first recognized and safeguarded by law some of these effects of the forest [on climate and water conservation] ... toward the end of the 18th century'' (173). More recent German scholars concur that much of desiccation theory began in France and spread to most of the rest of the world (Radkau, 2008: 218–219).

Concerns in France about deforestation, desiccation, and climate change do indeed have a very long history (Davis, 2016; Fressoz and Locher, 2015). The French began to worry about deforestation and both aridification and flooding in the 18th century. From that time, even before the French Revolution, these ideas and anxieties expanded and became more pronounced throughout the 19th century and into the 20th century. Great theoretical and scientific tracts about deforestation and climate change were penned and many laws, some of them draconian in application, were passed to reforest the country and restore its ecological balance.

Sixty years before George Perkins Marsh wrote his great synthetic work, *Man and Nature*, for instance, French writers including the geographer Francois-Antoine Rauch (1802) were expounding on the environmental evils of human agency, blaming the formation of deserts in the Middle East on rapacious deforestation by ancient civilizations. Theorizing at the dawn of the 19th century, Rauch was deeply informed by the works of Bernardin de Saint-Pierre and Pierre Poivre but he may have been the first to link environmental decline with civilizational decline using the example of ''oriental'' empires like Egypt and Mesopotamia (Davis, 2016).

Writing at the same time as Napoleon's ill-fated campaign in Egypt, Rauch warned, like so many after him, that if France did not protect and expand its forests, it would fall into decay and suffer the decline, politically, socially, and environmentally, of the ancient Middle Eastern civilizations, now lying in desiccated ruins buried in sand. This view became so widespread in Europe and America that it formed one of the primary lessons of Marsh's 1864 tome. In the words of geographer Michael Williams (2003), "deforestation and consequent aridity was one of the great 'lessons of history' that every literate person knew" during the 19th century (430).

It was commonly believed in the mid-19th century, in the words of the French scientist Antoine Becquerel (1853) that "the surface of the earth, at the moment humans appeared, was already covered with vast forests" (ii–iii).[16] While Becquerel called for the reforestation of mountains, the conclusion often drawn from this vein of literature was that every surface not under the plow or above the tree line should be (re)forested (Babinet, 1858). Others, such as M. Rouchon, as early as 1842, suggested that "the woods must be maintained or re-established in a rational relation with agriculture" (De Ribbe, 1857: 30). This was one of the earliest iterations of what would become the concept of the *taux de boisement normal*. Even earlier, in 1837, the lecture notes of the first director of the French forestry school at Nancy were published in which he stated that "it is therefore of the utmost importance for the climate of a country, that the forests be allotted in a suitable (proper) manner" to ensure adequate rainfall and prevent drought (Lorentz and Parade, 1855: 35).

In France, Germany, and most other European countries, these sentiments resulted in many reforestation laws, like the 1860 French Reforestation law, and a great wave of tree-planting that began in the mid-19th century. Much of this forest planting was carried out under the rules of sylviculture, or scientific forestry, with uniform species of trees, most often conifers which grew straight and fast and provided excellent timber (Naudts et al., 2016; Whited, 2000). This reveals the utilitarian/capitalist interest in reforestation that was all too often implemented in the name of environmental restoration in France and much of Europe. The questionable ecological outcomes of these efforts are detailed below. There were also a great many problematic social results from land and resource expropriation in the name of the "public utility" of forced reforestation, especially in southern France.

It was in this southern part of France that many writers including Rouchon, De Ribbe, and Becquerel developed their desiccationist arguments, directly linking forest cover with precipitation and tree loss with increased aridity. As detailed by Davis (2016), at this time it had become, common, but flawed, wisdom in much of Europe that deforestation and overgrazing created deserts. Many thus deduced that deforestation would create deserts in southern France comparable with Arabia, Egypt, and Syria (De Ribbe, 1857: 135). To quote Becquerel (1853) answering his own rhetorical question, "to what cause do we attribute the formation of these vast deserts in the interior of Africa? Deforestation!" (254).

Algeria and the *taux de boisement de civilization*

With its invasion of Algeria in 1830, France conquered part of the Sahara, the "vast desert in the interior of Africa" to which Becquerel was referring. By 1848, Algeria was formally and legally made an integral part of France, becoming its largest southern section comprised of three new departments (Oran, Algiers, and Constantine).[17] No longer merely a settler colony, Algeria, comprised of more than 75% desert, became the desert within France with some very interesting consequences. Having been preoccupied with deforestation, deserts, and the stabilization of sand dunes like those of the Landes of Gascony since the late 18th century, the French quickly developed grave anxieties over the state of Algeria's

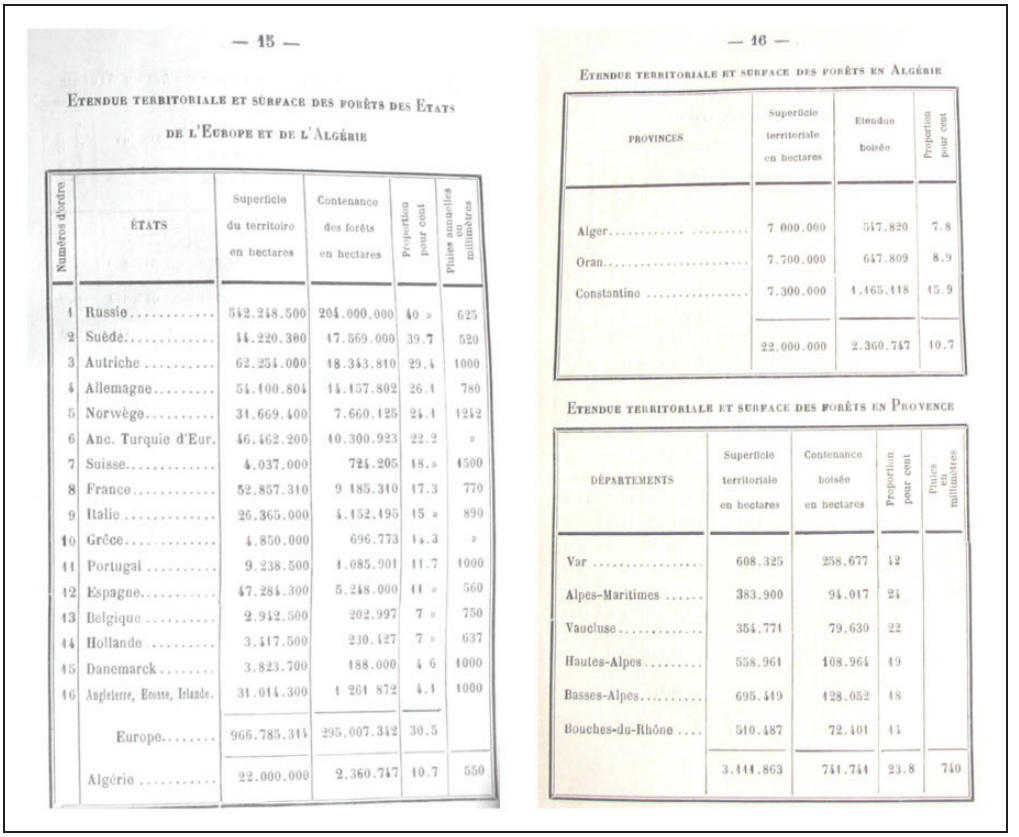
environment and climate, and what it portended for civilization and survival.[18] Whereas in much of France deforestation fears concerned both torrents/flooding and some desiccation in Gascony and Provence, in Algeria nearly all concerns focused on desiccation and aridification (desertification). It was in this colonial context, it appears, that the target of 30–33% forest cover necessary for "civilization" in the "hot" countries developed and was later exported to other parts of the world.

From the first years of the occupation in the 1830s, the story developed of the deforestation and desertification of Algeria at the hands of the "natives"—mostly due to the nomads. Following the military "pacification" of Algeria in 1851, this story became more widely accepted and by the 1860s it was dominant in Algeria. After the Franco-Prussian war, from 1871, it also became widespread in France. Given the prevailing received wisdom among Anglo-Europeans about trees promoting rainfall (Davis, 2016), it was all too easy to assume that Algeria was mostly a desert country because it had been deforested and overgrazed. The fear developed quite early that the more humid and vegetated section of northern Algeria, the rich, agricultural Tell, was at risk of desiccation and subsequent infertility from a northerly spreading Sahara desert. Claims made about "reforestation" bringing rains to Egypt and other places were easily and frequently marshaled into justifications for reforestation in Algeria (Clavé, 1862: 46). It was in the 1860s that connections began to be made comparing the *taux de boisement* of Algeria with the *taux de boisement* in France and in Europe more generally, a simplistic comparative methodology that would be widely adopted.

The influential French colonist Francois Trottier (1869: 19–20), for example, was one of the first to proclaim that Algeria should have a *taux de boisement* of at least 25%. A decade later Trottier (1876) had refined this figure, with many examples, comparisons with Europe, and elaborate justifications, and proclaimed that 33% was the proper or normal percentage of forest cover necessary for climate equilibrium and thus civilization in Algeria (91). Only this *taux de boisement* and the climate it would create could halt the "deterioration of climates caused by thoughtless deforestation" and support the survival of Europeans in Algeria (Trottier, 1876: 5). As Trottier (1876) explained, the wooded surface must be tripled so that "our race will conserve its European faculties; we must act against the climate if we do not want to be degenerated and absorbed by it; the tree must be the anchor of our salvation" (32). His solution was reforestation with eucalyptus—an Australian species recently introduced to Algeria.

Trottier also drew attention to other aspects of the deforestation/desiccation theories currently dominant in the western world. He made it clear that "the state of denudation of the soil exerts a great influence on the climate and thus on the moral state and the aptitudes of the inhabitants" (Trottier, 1867: 11). Because it was widely assumed that the Arab Algerians hated trees and deforested wherever they went, thereby creating deserts, Trottier (1876) proclaimed that "the Arab is a plague, he has always been so and he will be in the future; civilization must annihilate him, because he exists against providential destiny" (24).

The circular reasoning was that Algeria was deforested because the Algerians were uncivilized barbarian nomads and that therefore they needed to be tightly controlled if not exterminated to enable and enforce the reforestation necessary to ameliorate the climate and allow civilized Europeans to survive in a resurrected Algeria (Davis, 2007). Strains of environmental determinism and social Darwinism were strong in these narratives. Forests were credited with attracting rainfall, regularizing rains, preventing flooding and erosion, and drying up swamps—overall creating a more "healthful and productive" environment—for the "right" people.



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ETENDUE TERRITORIALE ET SURFACE DES FORÊTS DES ETATS DE L'EUROPE ET DE L'ALGÉRIE

Numéros d'ordre	ÉTATS	Superficie du territoire en hectares	Contenance des forêts en hectares	Proportion pour cent	Pluies annuelles en millimètres
1	Russie	542.218.500	204.000.000	40 »	625
2	Suède	44.220.360	17.569.000	39.7	520
3	Autriche	62.254.000	18.343.810	29.4	1000
4	Allemagne	54.100.804	14.157.802	26.1	780
5	Norwège	31.669.400	7.660.125	24.1	1242
6	Anc. Turquie d'Eur.	46.462.200	10.300.923	22.2	»
7	Suisse	4.037.000	724.205	18.»	1500
8	France	52.857.310	9 185.310	17.3	770
9	Italie	26.365.000	4.152.195	15 »	890
10	Grèce	4.850.000	696.773	14.3	»
11	Portugal	9.238.500	1.085.901	11.7	1000
12	Espagne	47.284.300	5.248.000	11 »	560
13	Belgique	2.942.500	202.997	7 »	750
14	Hollande	3.417.500	230.127	7 »	637
15	Danemarck	3.823.700	188.000	4 6	1000
16	Angleterre, Ecosse, Irlande.	31.014.300	1 261 872	4.1	1000
	Europe	966.785.314	295.007.342	30.5	
	Algérie	22.000.000	2.360.747	10.7	550

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ETENDUE TERRITORIALE ET SURFACE DES FORÊTS EN ALGÉRIE

PROVINCES	Superficie territoriale en hectares	Etendue boisée	Proportion pour cent
Alger	7 000.000	547.820	7.8
Oran	7.700.000	647.809	8.9
Constantine	7.300.000	1.465.118	15.9
	22.000.000	2.360.747	10.7

ETENDUE TERRITORIALE ET SURFACE DES FORÊTS EN PROVENCE

DÉPARTEMENTS	Superficie territoriale en hectares	Contenance boisée en hectares	Proportion pour cent	Pluies en millimètres
Var	608.325	258.677	42	
Alpes-Maritimes	383.900	94.017	24	
Vaucluse	354.771	79.630	22	
Hautes-Alpes	558.961	108.964	19	
Basses-Alpes	695.419	128.052	18	
Bouches-du-Rhône	510.487	72.401	14	
	3.111.863	741.741	23.8	740

Figure 1. Tables showing calculations of the *taux de boisement* (proportion) for Europe, France, and Algeria. Source: Reynard (1882: 15–16).

By 1882, the appropriate or "proper" *taux de boisement* for Algeria had been further refined by forest inspector J. Reynard (1882: 9), an 1862 graduate from Nancy, who calculated that it should be at least 33%. He derived this figure from a study of forest cover rates in Europe and in France, and especially in Provence, one of the southern territories in France. He included three tables of forest cover rates (for countries in Europe, in France, and in Algeria) (Reynard, 1882: 15–16). Simply by comparing these rates, he deduced that Algeria should be 33% forested since the average for Europe was about 30% and the average for Provence was 24%; but because Algeria was drier, it needed more forest cover to equalize the climate (Figure 1).

Just a few years later, the goal of 30% *taux de boisement* for Algeria had become widespread beyond foresters and was being advocated in major journals such as the *Economiste Français* (Anon, 1889: 109). Due in large part to the advocacy in these last two decades of the 19th century of the French Doctor, Paulin Trolard, and his Algerian Reforestation Ligue, the 30% *taux de boisement* was actually written into the landmark 1903 Algerian Forest Code as the "proper and normal" *taux de boisement* for Algeria and the goal to attain.[19] From this date, the idea of 30–33% *taux de boisement* being normal, correct, and attainable became dominant in the French Maghreb and is found throughout the literature and also in applied policies in Algeria, Morocco, and Tunisia.[20] In 1904, one year later,

forest inspector Reynard, echoing the geographer Rauch from a century earlier, invoked the 33% *taux de boisement* in his call for the reforestation of France. France, Reynard (1904) explained, needed to reestablish its climatic equilibrium with reforestation to the 33% *taux* because deforestation had led to climate deterioration and "climatic deterioration is a progression towards decadence and death" (5).

French forestry to India ... and beyond

By the turn of the 20th century, the concept of the *taux de boisement normal* of 30–33% had become widely known and appreciated in India, as well as throughout the French and British colonies in Africa and other tropical territories. From the Inspector-General of Forests in India, Ribbentrop, to the Director of Forestry in Madagascar, Girod-Genet, to the Governor General of Nigeria, Lugard, to the Inspector of Forests in Tonkin, Prades, the concept of the *taux de boisement* was beginning to inform forest policy by the first decade of the 20th century. By about 1925, the idea that there was a minimum *taux de boisement* that was necessary for climatic equilibrium, a fertile country, and "civilization" had practically become dogma throughout the colonial territories (Guillard, 2014 [1999]). Although the *taux* invoked by various actors sometimes varied between 25 and 40%, the 30–33% *taux de boisement* was the most commonly mentioned. Lord Lugard (1970 [1919]), for instance, citing forest conservator Thompson, instructed his political officers in Nigeria in 1918 that "where the water supply is precarious all true forest growth should be preserved, and that elsewhere not less than 33% should be reserved, as in India."[21]

The decade of the 1870s was particularly important for the spread of reboisement enthusiasm and the notion of the *taux de boisement* from France to India and beyond to other British and French colonial territories. As detailed above, it was in 1876 that the Algerian colonist Trottier wrote that 33% was the correct percentage of forest cover to ensure a good climate and thus civilization in Algeria (Trottier, 1876). This was the same year that major WI Seaton (1876), Conservator of Forests in British Burma, spent five weeks on an official study tour of forestry in French Algeria and wrote a 37-page report that detailed reboisement successes in Algeria and mentioned M. Trottier and his "several pamphlets on reboisement."[22] Moreover, M. Trottier, his experiences with eucalyptus and reboisement in Algeria, as well as his publications, are frequently mentioned in various articles of the *Indian Forester* during the last quarter of the 19th century. Indeed, from the first issue of the *Indian Forester*, forestry in Algeria (as in France) was closely monitored and discussed.

The year 1876 also marks the date that a new law came into effect in France mandating the teaching of both the theory and the practice of "reboisement" and the afforestation of both sand dunes and mountains at the national forestry school at Nancy (Guyot, 1898: 206, 345–347). It had been decided by the government that training was needed to successfully carry out the mandates of the 1860 law on the reforestation of mountains and the related law of 1864 on the "regrassing" of mountains. For this a "special course" dedicated to the "fixation of dunes, the reboisement and the grassing of mountains" was added to the curriculum (Mathieu, 1878: 544–545). Forestry in Algeria was included in this program (Mathieu, 1878: 492). Thus all graduates of Nancy from at least 1876, and probably earlier, were trained in reboisement, dune stabilization, and taught about Algerian forestry.

Further spreading knowledge and enthusiasm about reboisement was the special exhibit at the 1878 World's Fair in Paris put together by the French Forestry Administration. As reported in the *Indian Forester*, this exhibit, housed in the Forestry Pavilion, was an elaborate display of the successes of reboisement, "the great work which offers a remedy

to torrent'' (Thelu and Baden-Powell, 1878: 266). It contained 6 models (with relief), 66 photographs (before and after reboisement), 7 drawings, 4 maps, and several sketches, and was ''thronged'' by crowds (Thelu and Baden-Powell, 1878: 261). British India also sent a display to the forestry pavilion and this World's Fair provided an opportunity for the exchange of information on forestry among many different countries. The success of France's reboisement of the eroded slopes of the Southern Alps became widely known and formed a base of knowledge that was adapted and followed by many countries.[23]

At this time in India, the impulse to ''reforest'' came less from needing to deal with torrents and erosion than from a growing sense of urgency about the climate in general and agricultural productivity in particular. The 1878 World's Fair took place just as the great famine of 1876–1878 was ending and the terrible toll of over five million dead was beginning to be realized. A special Famine Commission was tasked with determining the nature of the problem and what to do about it. Directing his comments to the members of the House of Commons conducting the investigation, Surgeon-General Balfour reminded readers that ''after the reports of the Madras officers were received, orders were issued to conserve forests, to plant trees, and to protect the springs'' and that the 1878 amended Forest Act was submitted to the Legislative Council of India with the exhortation that ''without effective regulation and conservation of forests, not merely the public revenue but the public themselves, would suffer, and even risks of famine would be infinitely incurred'' (Balfour, 1878: 134). After 34 pages of tightly documented arguments, Balfour (1878) concluded that a combination of the reservation of forests and reforestation ''will early secure a more equitable supply of water in the rivers, canals, and reservoirs, permit cultivation and population to increase, and render scarcity and famines of less frequent occurrence ... and lives, property and revenue saved'' (147).

Based on the many mentions of the primary French forestry journal, the *Revue des Eaux et Forêts*, in the pages of the *Indian Forester* from its very first issue in 1876, it is clear that many foresters in India regularly received and read this influential journal. Through such journals as well as many French forestry monographs that were translated into English, such as Nancy professor Bagneris' *Elements of Sylviculture* (translated in 1876), both reforestation enthusiasm and the concept of the *taux de boisement normal* were spread widely in the Anglophone as well as in the Francophone world. It is therefore not surprising to find the Inspector-General of Forests in India, Ribbentrop (1900), calling for the reforestation of all India to attain the 30% *taux de boisement* in 1900 as noted above. The first decades of the 20th century saw the further spread of the concept and practice to most British and French colonial territories in Africa and in some cases far beyond the continent (Guillard, 2014). It spurred a large number of reforestation and afforestation projects, many of which did not succeed ecologically but did marginalize local populations.

The Director of Forestry in colonial Morocco, Paul Boudy, summed up the prevailing beliefs in 1927 during a lecture he gave to some colonial officers newly arrived in the French territory. He explained that

> it is scientifically proven that the formation of sand deserts ... is due to deforestation, the work of ancient nomadic peoples.... A certain proportion of forest is in effect indispensable for a country to be really habitable ... this proportion has been fixed theoretically and practically at 30%. (Boudy, 1927: 10, 21–22)

Boudy based this on the prevailing thinking about forest cover rates and climates appropriate for European habitation but also on some historical deductions. He believed that since Roman civilization had apparently flourished in the ancient Maghreb, it must have

been at least one-third forested during the Roman period or their civilization could not have survived. The way forward was to reforest Morocco and the entire Maghreb to try to attain the 30% *taux de boisement de civilization*.

This stubbornly tenacious goal of 30% forest cover appears to have remained surprisingly influential and has informed reforestation policies and programs in many colonial and postcolonial territories into the 21st century. Mirroring India's National Mission, Algeria, currently has the goal of attaining 20–25% *taux de boisement* since it is the "generally accepted norm" (Algérie, 2003: 3). Several of these policies have been socially repressive such as Algeria's Green Dam, a 1500 km line of trees, which dislocated and sedentarized numerous nomads in the 1970s and 1980s, in order to "hold back the spread of the Sahara." The Green Dam and many other similar projects justified with such policies have also been ecological failures with the native vegetation disrupted and the plantations unsuccessful, now comprised primarily of stunted or dead trees (Davis, 2007).

The deeply colonial idea of the need for about one-third forest cover to support "civilization," we need to recognize, was primarily developed by Europeans during the colonial period, based in large part on their experiences in their dryland territories, and then applied in arid and semiarid imperial settings such as Algeria and India. This ideal *taux de boisement* was furthermore based on profound misunderstandings of these drylands that resulted in policies that were particularly inappropriate for the drylands (Davis, 2016). The push for reforestation and afforestation to attain the 30% *taux* was accompanied by laws and policies to protect existing forests—often entailing fire and grazing suppression as well as the expulsion of indigenous populations from living in or near forests and the sedentarization of nomads.[24] These policies were particularly pronounced in the French Maghreb and British India and they are still influential today.

Conclusion: From pathologized populations to plantation pathologies

As recent literature has made increasingly clear, though, planting trees in such arid and semiarid biomes, which more "naturally" support grasslands or shrublands, is commonly ecologically harmful. Such afforestation results in lowered water tables, changed hydrological systems, reduced streamflows, decreased soil carbon storage, and negatively altered nutrient cycles (Robbins, 2001b; Veldman et al., 2015a, 2015b). The arboreal chauvinism that drives this kind of narrow policy development and implementation, however, is an important legacy of the long intellectual and policy history laid out here. Moreover, its implications are not limited to the postcolonial drylands that have been the focus in this paper. One of the environmental results of centuries of reforestation ideology, most notably, has been an enthusiasm for tree-planting for climate change mitigation, despite ambiguous evidence. As Naudts et al. (2016) have recently demonstrated, "not all forestry contributes to climate change mitigation" (597).[25] Indeed, some interventions exacerbate climate change, rather than mitigate it.

Carbon sequestration via tree plantations, using well-selected species, can likely produce negative emissions and serve as climate mitigation services in some of the more mesic parts of the world. Problems, however, especially in the drier parts of the world, are being increasingly recognized. In biomes such as grasslands and savannas, for example, afforestation has been shown to negatively impact biodiversity, soils, and hydrology (Abreu et al., 2017; Veldman et al., 2015a). Moreover, a number of studies point to severe constraints in terms of both land availability (agricultural competition) and water scarcity to negative emissions with plantations (Jans et al., 2018; Séférian et al., 2018). Some of these studies conclude that relying on negative emissions is a "highly uncertain strategy"

(Krause et al., 2018) and that this "strategy is not a viable alternative to aggressive emission reductions" (Boysen et al., 2017: 463).

This mentality, however, is driving the afforestation of rangeland in the US and elsewhere in the name of carbon sequestration that is likely to have very negative environmental and social impacts (Booker et al., 2013). This loss of rangeland is troubling since research has repeatedly demonstrated that extensive pastoralism is the most ecologically appropriate and sustainable use of a substantial majority of the drylands, in particular those with nonequilibrium ecological dynamics (Behnke and Mortimore, 2016; Davis, 2016; Engler and Von Wehrden, 2018; Kratli, 2015; Sayre et al., 2017). Moreover, recent research has highlighted that such pastoralism has been ecologically appropriate and adaptive since at least the mid-Holocene, a time during which "pastoralism did not accelerate aridification, and may even have delayed the collapse of the green Sahara" (Brierly et al., 2018: 7). These authors conclude that "promoting and enhancing sustainable pastoralism could be a vital adaptation to our current climate challenge." This is so because grasslands "store as much carbon as forests do globally" (Veldman et al., 2015a: 1011) and they are a "more resilient carbon sink than forests" in the face of droughts, heat extremes, and wildfires (Dass et al., 2018). It would seem it is time, then, to rethink the "Tyranny of Trees" (Veldman et al., 2015b) with more careful, empirical, and theoretically informed research—especially in the nearly half of our landmass that is the drylands. Indeed, it is the drylands with their nonequilibrial ecosystems that have recently been demonstrated to be the least sensitive to climate variability, despite (neo)colonial narratives that have usually claimed otherwise (Seddon et al., 2016). The National Mission for a Green India, then, recapitulates a colonial heritage that allows arbitrary afforestation goals to survive, despite growing empirical tests that increasingly show their flaws.

The actual impacts of the National Mission, and other similar programs, cannot be known to us without a close assessment. We can only know by empirical observation how more trees on the land will impact local ecologies, economies, and communities, potentially shifting the power of actors in communities, regions, and states into the future. Tracking and documenting these large-scale forestry programs like the National Mission, in action, deserves its own research agenda.

Even without such rigorous observation, the stubborn history of afforestation described here already highlights several general lessons. First, the case shows the remarkable tenacity of core environmental concepts handed down from colonialism. The use of forestry as a socioecological panacea has shown the ability to travel widely, be deployed in a wide range of contexts, and to capture the imagination of environmental managers over many centuries. As suggested here, these specific ideas reinforce habits of governance that are convenient to postcolonial states.

This is because tree-planting renders basic problems in development as technical and antipolitical. As in Tania Li's violent landscapes of Indonesian development, the assemblage that surrounds afforestation in India—consisting of remotely sensed images, massive labor mobilizations, countless nursery complexes, and an army of forestry experts—allows the staggering environmental challenges of the country to become "statistical measures of progress that [are] always positive if not optimal." As such, the technics of tree-planting specifically "limit debate about the purpose of development and its distributive effects" (Li, 2007: 57). Environmental management has long been recognized as a critical part of development's antipolitics machine (Ferguson, 1994), but as shown here, for its tenacity, scale, and entrenchment, tree-planting is perhaps the apotheosis of that engine.

Second, this study has revealed the specific role of colonial French forestry as critical for contemporary development. This finding minimally suggests that the French tradition in

forestry deserves renewed investigation, especially relative to its German counterpart, which has already been shown to be so crucial to contemporary outcomes. Attention to French forestry traditions, however, also directs our focus toward the operation of markedly different modes of governance in the colonial and postcolonial era. As shown here, the civilizational urge in French afforestation traditions, distinct from narrowly ecological/economic knowledge traditions, is one that merges the management of trees with the management of people, and that enrolls colonized subjects in the proliferation of state ecological practice.

When one million volunteers are mobilized to improve the landscape, the tacit understanding is that the effort will improve citizens themselves. This represents a biopolitical, and not merely state hegemonic, vision for the role of forests, forestry, and foresters. As with public hygiene and social medicine, this vision of forestry also emerges in the colonial context of the 19th century, addressing a population as, in the Foucaultian (2007: 367) sense: ''a set of coexisting living beings with particular biological and pathological features, and which as such falls under specific forms of knowledge and technique.'' For French, and subsequently many other colonial foresters, the pathologized landscape and the pathological colonized subject are together to be self-governed through the ritual of tree-planting, an arboreal biopolitics which unites them both: trees and people, in ecological and political health.

Moreover, this outcome also parallels myriad other cases within the field of political ecology where conservation is bound up with control, whether in the creation of parks (Brockington, 2002; Neumann, 1998) or the installation or demolition of dams (Sneddon, 2015). These persistent efforts at tree-planting reflect a more specific state logic, however: the construction of territory through calculation, reflected in large-scale land management more generally. This critical component of modern governance, as understood in political geography, evolves precisely in the period that the *taux* is formulated and first deployed, but remains consistent with state logics through colonialism and beyond. As noted by Elden (2007: 578), and following on the work of Foucault, the calculation of landscapes is critical for state control.

Starting in the 18th century, land becomes (like population) ''something that is understood in terms of its geometric, rational properties, or 'qualities'. Territory is more than merely land, but a rendering of the emergent concept of 'space' as a political category: owned, distributed, mapped, calculated, bordered, and controlled'' (Elden, 2007: 578). State agents charged with calculating, and necessarily quantifying, metrics of land are vehicles for the extension of state power through territory. Thus, foresters continue to promulgate trees and their metrical extent (as a fixed percent of total land), not because they are oblivious to the arbitrariness of the exercise, or even its futility. Instead, they act with perfect consistency within the necessary logic of state power. The recent impetus for compensatory afforestation in India, for instance, especially where conducted on nonforest lands, imposes new restrictions on land use, effectively extending Forest Department control to new land (Kodiveri and Karthik, 2018).

Perhaps most importantly, though, we need to acknowledge that the *taux de boisement* was, and remains, a measure of something more. Given that forest cover of Europe in the colonial period was estimated at roughly one-third, and that this region served as the source of knowledge, law, and statecraft, a *taux de boisement* of 30–33% became the widely accepted minimum for civilization, and so was chosen as the reforestation target imposed upon colonies throughout North Africa. Exported to India, this targeted minimum, it can easily be concluded, became a conceptual ghost that haunted successive generations of forest policy makers, whose goals might have been diverse—a timber economy in 1952, livelihood promotion in 1988, and climate control in 2011—but whose mechanisms represent a disordered form of repetitive compulsion, imposed over and over on arid and semiarid ecosystems and the local communities who know them best.

Ultimately, the heritage of these environmental policies and the conceits upon which they are built demand decolonization of both knowledge and policy implementation. We may well find the answers to "maintaining civilization" only when we set aside our saplings and instead listen closely and patiently to the environments and indigenous peoples of the world's drylands.

Highlights

- Contemporary afforestation goals often assume arbitrary targets that are rooted in habits of (neo)colonial governance rather than sound science.
- The critical role of French forestry traditions in South Asia has been underestimated in previous research.
- Afforestation is shown to be an instance of state territorialization: the extension of state power through categorizing and counting.
- Tree-planting has been lauded as an environmental panacea for at least 200 years but often functions as a form of biopolitics.

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Notes

1. One year later, in July 2017, another attempt was made to break the world record when 1.5 million volunteers reportedly planted 66 million trees in only 12 hours in Madhya Pradesh (Baynes, 2017).

2. "Forest cover" includes lands more than 1 hectare with more than 10% tree canopy and irrespective of that land's ownership and legal status (FSI, 2015: 25). To the best of our knowledge, this article is the first to analyze the deep history and contemporary relevance of "forest cover," the taux de boisement, going deeper historically and revealing the importance of Algeria and the French Maghreb for the development of the taux. Only Guillard (2014 [1999]) touches on the taux de boisement but traces its first use to the late 1890s and concludes his analysis in the 1950s as part of his detailed history of the overseas French Forest Service.
3. The 1894 Forest Policy was not based on the 1878 Indian Forest Act per se, but rather on circular 22-F of 1894, which was based on chapters 8 and 9 of Dr Voeleker's (1893) *Report on the Improvement of Indian Agriculture*. The next Forest Act was not passed until 1927.
4. Nor do the 1865 or the 1878 Indian Forest Acts indicate a target percentage of forest cover, or *taux de boisement*.
5. See discussion of Schlich in Rajan (2006).
6. See *The Indian Forester* (1908) Vol. 34, No. 5, pages 312–314 and 621–622.
7. See *The Indian Forester* (1928) Vol. 54, No. 2, pages 73–75; (1929) Vol. 55, No. 11, page 639, and Vol. 55, No. 12, pages 690–691.
8. For more details, see Rajan (2006) and Barton (2002).
9. The words reforestation and afforestation are often used interchangeably but reforestation implies that the area being planted was previously forested and then deforested, whereas afforestation usually applies to areas being planted that are not believed to have been previously forested. In French, reboisement means reforestation in areas thought to have been deforested. Reforestation, however, can also be used ideologically to try to claim nonforested land as forest land simply by identifying "reforestation perimeters." This was done, for example, in the colonial Maghreb with large expanses of Halfa grass pastures and other nonforested lands (Davis, 2007).
10. Gifford Pinchot, for instance, received postgraduate training at Nancy for a year, returning to the US in 1890.
11. An official French regulation governing the studies of English students at the forest school at Nancy was passed in 1867 (Brandis, 1873: 174–176). Statistics cited for the number of English students at Nancy vary slightly by source from 81 to 84.
12. By 1885, most British foresters were being trained at the new English forestry school at Cooper's Hill College in Surrey. In his retirement, Pearson served at Cooper's Hill College from 1884 to 1902.
13. See Guha's (1990) analysis of the elaborate discussions and debates of French and German forestry by the British foresters in India during the 1870s and Saberwal's (1998) description of foresters like Baden-Powell taking serious note of foresters and torrents/flooding in France in the 19th century. See also discussion in Guha (1983).
14. German publications and authors, although sometimes discussed, received less attention than French sources.
15. For a discussion of Balfour and of desiccation theory (the notion that deforestation causes aridification and that reforestation brings back the rain), see Davis (2016) and Grove (1995). Desiccation theory became widely dominant among a majority of Anglo-Europeans during the 19th century and was especially influential in their dryland colonial territories. Many of the assumptions built into desiccation theory have been called into question and even proved incorrect over the last few decades. Part of the reason is the revolution in scientific ecology that has taken place over the last quarter century and especially in arid lands ecology. This new research, as detailed in Davis (2016), shows that a majority of the earth's drylands are not governed by equilibrium ecological dynamics and therefore our mainstream ideas of ecological succession do not apply well if at all. Therefore, our traditional understandings of trees and forests, derived from European standards and understandings, also frequently do not apply for a wide variety of reasons in the drylands. In such dryland nonequilibrial environments, abiotic drivers, especially rainfall, are more significant and water is often the strongest limiting factor. Planting more trees in such environments often leads to lowered water tables and other ecological problems as explained in Davis (2016). This is particularly important for understanding the needless blame

placed on pastoralists and their livestock for overgrazing, deforestation, and desertification over the last two centuries—they did not create deserts and planting trees in drylands presumed to be degraded has been a failed strategy around the world.

16. Becquerel included a typical chart of the ''taux de boisement'' along with the proportions of other types of land cover/use in this widely read book (240).
17. Later the southern, ''Saharan,'' territories were added.
18. For details on the Landes of Gascony and stabilization of coastal dunes with Pine plantations, see Davis (2016: 76–78).
19. For details, see Davis (2007: Ch. 4).
20. The Algerian Forest Code formed the basis of both the Tunisian forestry laws and the Moroccan Forest Code of 1917—still in force today. The Algerian Forest Code also formed the basis of the forest laws of other French colonial territories including Madagascar and French West Africa (Davis, 2016: 215–216).
21. Forest Director H.N. Thompson came to Nigeria in 1903 with a dozen years' experience in British Burma (Von Hellerman and Usuanlele, 2009).
22. This report entered the collection of the British Library in 1878 and a second copy is held in the India Office Library with the stamp ''Secretary of State for India Library'' on the front.
23. The most important figure in the development of the ideas and methods to reforest the Alps was Prosper Demontzey, a forester trained at Nancy (class of 1852), who worked in Algeria on reboisement for a decade from 1853 to 1862 (AIGREF, 2001).
24. For details on this ''standard suite'' of policies for developing the drylands, of which trying to attain the 30% *taux de boisement* was often a crucial part, see Davis (2016).
25. This article details two primary mechanisms by which warming was exacerbated by reforestation/afforestation and organized forest management in Europe since about 1750. The first is the release of carbon otherwise stored in wood, litter, and soil carbon. The second, less noted in the literature generally, is the change in albedo and evapotranspiration from the conversion of deciduous forests to coniferous forests over time.

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