Introduction

The importance of forests and trees in South African history

How exotic trees are managed in South Africa is a contested subject. One can quickly ascertain the contested nature of this issue by asking people their opinion about exotic trees or by reading articles in the opinion section of newspapers advocating for and against the removal of exotic trees.¹ Some South Africans want to maintain existing exotic trees or even plant more to expand the economy, maintain heritage aesthetics, and provide shade in treeless environments. Environmentalists, government policy, and international advocates are more critical of exotic trees, which are seen as a threat to the integrity of indigenous ecosystems, the survival of threatened species, and the conservation of water. Advocates of tree planting worry that criticisms of invasive trees and the existing water legislation is a threat to the viability of the timber sector, an important contributor to the national and regional economy. Yet critics argue that biological invasions already cost billions of Rand in possible revenue and use South Africa’s limited water supplies. Climate change projections suggest that the south-western part of the country, which is the most invaded, will see declining rainfall. The issue is complex and requires a nuanced understanding that is evidence-based and takes into account social, economic, and environmental considerations.

Whatever the perspective, it is undeniable that exotic trees are a significant part of South Africa’s ecosystems, economy, and modern history. One cannot drive throughout the upland areas of the KwaZulu-Natal, Mpumalanga, or Limpopo provinces without seeing large plantations of introduced species of Acacia,

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*Eucalyptus* and *Pinus* stretching across the countryside. A small percentage of the country’s plantations can be seen in select locations in the Western Cape Province. There are an estimated 650,000 hectares of *Pinus*, 500,000 hectares of planted *Eucalyptus*, and 100,000 hectares of Australian *Acacia* (called wattle) in South Africa. Other populations of exotic trees, some of them self-reproducing and others the remnants of past planting efforts, dot millions of hectares of land.

Despite negative to neutral public attitudes towards planted trees, there are significant benefits that flow from planted exotic trees in South Africa. Exotic trees support a multi-billion Rand timber industry concentrated in the country’s higher rainfall regions in its northern and eastern provinces. Plantation-grown timber is used to make products as diverse as sawn timber boards, mine support packs, cellulose pulp for rayon, pressed board, the poles that are used for the safari architectural style seen at national parks and game lodges, and in indigenous fences and housing. South Africa is home to two of the world’s largest multinational forest products companies, Sappi and Mondi, companies that originated from private afforestation programs during the first half of the twentieth century. The South African company Steinhoff International started operating in South Africa using domestic timber resources; from this base it became the second-largest furniture company in the world. No other country with comparable environmental resources has a forest product sector that is so productive. The question of how South Africa, a country that is naturally deficient in forests, created such a dynamic forest sector is one that has not been subjected to proper investigation. Though the main contributions are economic, planted trees also contribute positively to ecosystem services in many regions, the most obvious being north-east South Africa where the afforestation along the escarpment improves the quality of water flowing through the Kruger National Park.

Yet there are powerful reasons to be wary of planting exotic trees in South Africa that are known invaders or planting trees in catchments with water shortages. The ecological impact of planted and invasive exotic trees is substantial. Tree planting significantly changed the landscapes and ecosystems in South Africa. Invading alien trees are one of the greatest environmental threats in South Africa. Ecologists and environmental managers now seek to remove and manage invasive trees that form dense groves along river and stream banks, and in water catchment areas, and that outcompete indigenous vegetation. Over half a billion dollars (USD) has been spent by the Working for Water program to remove invasive plants, mostly exotic trees such as *Pinus pinaster* and *Acacia mearnsii*. These removals are based on the recognition that exotic trees use more water than do indigenous vegetation types, such as grassland or fynbos (a heath and shrub-dominated vegetation type). In a country with limited water supplies, invasive trees can create economic as well as conservation problems. The removal of invasive species is part of a wider effort to preserve the country’s unique
biological diversity, especially in the species-rich fynbos in the Western Cape Province, a biome that is significantly invaded. Without radical interventions, large swaths of the world-famous fynbos will become highly invaded ‘novel ecosystems’ with little chance of them returning to their previous condition.

Academic discussions about exotic trees usually focus on ecological, economic, heritage, or aesthetic considerations. The most well-developed scholarly literature focuses on the dynamics of invasive exotic plants, water conservation, and biodiversity management in South African and global contexts. South Africa is seen as a type of a global ‘model’. South African researchers have since at least the 1980s been recognised as global leaders in invasion biology and ecology, with a particular emphasis on exotic trees. At the same time, South Africa’s efforts to control the spread and impact of trees through Working for Water have often been praised by members of the international scientific community for creating a world-leading program that targets invasive species and provides employment for disadvantaged South Africans.

Though many scientists around the world know about South Africa’s current research and policies, much less is known about how these evolved out of a long-term research program on forest hydrology. That program—its origins, development, and legacy—is the focus of this book. It is difficult to properly understand South African environmental history or the country’s current research agendas and state legislation and policies without knowing about this program. The historical analysis offered in this book provides knowledge that can be used to assess and continue to improve South Africa’s national policies and legislation. The history of tree planting and forest hydrology discussed in the book should be of interest to scholars in China, Australia, and India, among other places, because the issues addressed—how to balance ecological and economic considerations when planting trees—are salient. It is also important for hydrologists and foresters because South African research in forest hydrology helped to produce knowledge that is foundational within each discipline today.

While the book uses history to contribute to science and policy, it concurrently seeks to add to research on South African environmental history. There are many new developments within the field of South African environmental history, a sub-field that originated in the 1980s and has progressively developed since then. In the past decade, historians have turned their attention to how valuations of ecosystems and indigenous and exotic species changed throughout
the twentieth century. This work demonstrates that contemporary attitudes celebrating indigenous species and criticising exotic species grew stronger during the second half of the twentieth century as a result of environmental, political, and cultural trends. Another important development within the field is the growth of scholarship that seeks to engage with ongoing policy issues, and to use history to inform policy and science. Historians are increasingly seeking to engage with scientists on key issues, while there is an equally growing interest among scientists to learn from history in order to assess and solve environmental problems, such as biological invasions.

This book adds to the fields of history and science by focusing on the wider history of forestry, especially timber plantations and hydrology. Forestry played a pivotal yet hitherto under-recognised role in shaping the history of South Africa’s environmental sciences, economy, and its ecosystems. Unlike other countries with more developed forest histories, South Africa lacks an authoritative history of forestry or its forests. Foresters have written most histories of forestry, and these histories are rarely based on archival research and tend not to situate themselves properly within the wider historiography.


5 Much of this work is being driven by David Richardson and the Stellenbosch Centre for Excellence in Invasion Biology. Timm Hoffman at the University of Cape Town has demonstrated the value of repeat photography in assessing landscape changes. Scientists and managers in South Africa express a growing interest for historical information.

6 There have been some publications covering specific aspects. See M. Lawes, H. A. C. Ealey, C. M. Shackleton, and B. G. S. Geach (eds), Indigenous Forests and Woodlands in Southern Africa: Policy, People, and Practice (Pietermaritzburg: University of KwaZulu-Natal Press, 2004).
of South Africa and the world. For their part, professional historians have focused their attentions on larger problems (e.g. white supremacy, colonisation, African resistance and agency) within social, economic, and political history. The history of forestry, with a few important exceptions, has been relatively neglected as a subject.

The history of South African forestry is significant for many reasons, but this book focuses specifically on three areas where it is of particular importance for understanding South Africa’s environments, past and present. First, we argue that the environmental constraints in Southern Africa led the first generation of state foresters to focus their efforts on establishing exotic timber plantations. Foresters in Southern Africa devoted more efforts to plantations—their establishment, management, and utilisation—than any other issue. Only by understanding plantations is it possible to situate historical debates about water conservation or scientific concerns about invasive plants. Our focus on plantations builds on the existing historiography, which has usually been divided between studies that focus on the ‘external’ origins of forestry or pursue detailed regional histories without situating them in national and global contexts. This emphasises the importance of developments and impacts, and through this we seek to understand how South Africa’s forestry and water policy framework evolved across the twentieth century.

Second, we propose a theoretical explanation for how human interaction with environmental constraints led to the creation of new ecosystems, scientific ideas, and conservation policies in South Africa. The theoretical framework attempts to describe how key interactions between humans, non-humans, and the wider environment changed in Southern Africa during the periods from the onset of European colonialism to post-apartheid. The model accounts for the history of tree species introductions by explaining why some tree introductions ‘succeeded’ and ‘failed’ from biological, ecological, and social perspectives. The key question is to explain why the success rate of species introductions improved during the twentieth century. To explain this, we focus on foresters who created a methodology for selecting exotic trees that sought, in the words of the Cape forester David E. Hutchins, to ‘fit the tree to the climate’.

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8 See J. Tropp, Natures of Colonial Change in the Making of the Transkei (Athens, OH: Ohio University Press, 2006); Pooley, Burning Table Mountain.

9 Pooley, Burning Table Mountain, is an exception.
Cape foresters’ emphasis on bio-climatic comparison and matching, and their interest in experimenting with exotic trees, helps explains the success of exotic tree plantations in South Africa in the twentieth century. Successful bioclimatic matchings is one reason why South Africa has one of the highest percentages of trees as invasive plants of any region in the world.\(^{10}\)

Third, the book traces the history of hydrological research and policy in South Africa by focusing on the evolution of ideas, science and institutions relating to forests and water. The history of hydrology in South Africa is significant because it shaped modern understandings of catchment hydrology and invasive species, as well as created a coherent national framework for afforestation. Current management programs, such as Working for Water, developed out of the sustained, national effort to determine whether tree planting had a negative or positive influence on the water balance of South Africa’s catchments.

This effort began in earnest with the establishment of a research station in 1935 in the Jonkershoek Valley, just outside of the university town of Stellenbosch. Researchers from Jonkershoek played a disproportionate role in creating the scientific concepts and national legislation used to manage plantations, catchments, and invasive species at regional and national scales. The interdisciplinary effort in the program led to the creation of a national framework that sought to reconcile competing interest groups (e.g. foresters, downstream users, and ecosystems) by directing afforestation toward regions in the country where it was environmentally and economically appropriate. This policy began to break down in the late 1980s to late 1990s during the transition towards democracy. The new regulatory regime that came into existence in the 1990s included the *National Water Act* of 1998, a piece of legislation that defined forestry as the country’s only streamflow reduction activity.

### Reorienting South Africa’s forest historiography

South Africa has a unique forestry history that deviated from European and Indian traditions soon after its inception as a state program in the Cape Colony in the early 1880s. The first generation of professional foresters in the Cape Colony faced the tasks of protecting and managing scarce and dwindling resources of indigenous, mixed-species forests; conserving water in an arid climate; and creating plantations from the ground up in unknown environments with

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\(^{10}\) Scientists have recognised since the 1980s that forestry has left a legacy of invasive alien species in different regions of the world. See D. M. Richardson, ‘Forestry Trees as Invasive Aliens’, *Conservation Biology*, 12 (1998): 18–26. It has only been recognised recently that the history of bioclimatic matching in South Africa may go some way towards explaining the proportionally high number of of naturalised and invasive forest tree species. See J. E. Donaldson, et al., ‘Invasion Trajectory of Alien Trees: The Role of Introduction Pathway and Planting History’, *Global Change Biology*, 20 (2014): 1527–37.
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almost no suitable indigenous species from which to select. Foresters turned their attentions to tree planting, an action they believed would encourage soil and water conservation as well as alleviate the pressure on the country’s finite indigenous forests.

Not only did environmental constraints limit foresters, the economic demands caused by the mineral revolution—based on the mining of diamonds from the early 1870s and gold from the late 1880s—generated massive need for timber for mining. Neither the Cape nor Transvaal had adequate supplies of indigenous forest to provide for these demands. Private producers soon entered into the market, but with little success because they lacked the knowledge of which species to plant and how to manage them. Foresters from the Cape who moved to the Transvaal after the South African War were tasked with making sure the mines were provided with timber. Foresters had a difficult task: there were few indigenous forests and fewer plantations.

As a result of their emphasis on tree planting, foresters in the Cape, and eventually foresters throughout the rest of South Africa, developed their own identity in contradistinction to their European or British Empire counterparts. South African foresters saw themselves as innovative creators of new forest systems rather than the more traditional manager’s role as a conservator of existing forests. The rapid expansion of plantations led critics outside and inside of South Africa to worry that plantations had negative conservation consequences on indigenous vegetation and hydrological regimes. Fears about the desiccating influence of certain exotics, such as eucalypts, were expressed in the mid-nineteenth century, but these concerns become more pronounced in droughts during the early twentieth century.

This argument amends historical interpretations that imply that the forestry regime that developed in South Africa was ‘European’ or ‘Indian’ in theory and practice. It is undeniable that forestry science originated first in Europe and spread throughout the world through globalisation. India, too, acted as a central hub in the development of an ‘empire forestry’ movement, which spread the gospel of forestry conservation throughout the British Empire. For the past decade these diffusionist studies offered a useful framework that helped to understand how professional foresters spread state forestry globally. Yet there is now a growing recognition of the limitations of global diffusionist perspectives, which often obscure cross-imperial networks, national histories and the importance of

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place. Unlike Australia and New Zealand, where forest historians have amended these frameworks, South Africa’s forest historiography, with a few exceptions mentioned below, has remained anchored to these origins stories.

A series of studies by Bennett have argued that South African forestry deviated from European practice and principles soon after the arrival of professional foresters in the 1880s. This book draws on and advances this argument by documenting how foresters from the Cape developed unique ideas about the importance of bioclimatical modelling. By the mid-1900s, foresters opened up the first African forestry school in order to train students about the unique problems associated with forestry in Southern Africa. South African foresters developed distinct practices for selecting species and creating plantations that created considerable international interest, and even controversy, that lasted until the 1950s. Forest hydrology research in the 1950s and 1960s also generated considerable controversy among leading hydrologists. Interestingly, in each case—climatic modelling, plantation methods, and hydrological research—South African methods eventually gained international acceptance, and even became standard procedures elsewhere in the world.

Plantation-grown timber output increased steadily throughout the twentieth century, following from steady afforestation in the period from the late 1920s to the 1930s, culminating in the 1960s to the 1970s. This expansion reflected sustained government investments to expand timber plantations in grassland or shrubland around or between patches of indigenous forest. Government plantations were composed primarily of pines (\textit{P. radiata} in the Mediterranean climate of the Cape and \textit{P. patula} and \textit{P. elliottii} in the summer-rainfall eastern provinces). Private plantations expanded at an even faster rate throughout the twentieth century in response to domestic demand for eucalypt mine-support timbers and global demands for wattle bark, and later, pine and eucalypt paper and cellulose pulp.


Exotic trees reshaped ecosystems and created new economies and social communities.\textsuperscript{14} Plantations drew praise and criticism. Examining the history of plantations offers a way to tie together hitherto fragmented strains in fields as diverse as environmental history, social history, economic history, the history of science, global history, and political history.

At the most basic level, plantations required land and human labour to plant trees. Finding labour and sufficient land proved to be an early problem for South Africa's foresters. In many districts, labour was initially scarce, and attempts by government foresters to hire locally agitated the white farming community, who feared competition for workers and increased wage burdens. After Union, foresters found themselves embroiled in political interventions to reverse urbanisation and address the ‘poor White problem’\textsuperscript{15}. This led to a national program for buying and appropriating land suitable for afforestation and establishing white forestry settlements. Alongside these settlements, government instituted a discriminatory system that subsidised wages for whites and paid African and coloured labourers less for similar work.

The increased output of timber grown in domestic plantations partially explains how South Africa’s small, indigenous closed-canopy forests stayed largely intact throughout the twentieth century. By the early twentieth century, most of South Africa’s remaining indigenous forests around Knysna, the Transkei, Natal, and Transvaal had been placed under the control of state foresters.\textsuperscript{16} Foresters negotiated with and often struggled against white landowners, politicians, diverse groups of woodcutters, and rural African communities in order to demarcate and control South Africa’s finite and scattered forest resources. Once demarcated and policed, the Forestry Department had to figure out how to regulate the harvest from indigenous forests. They established a research program in the early 1920s to investigate how to regenerate and sustain native tree species. The first ecologist employed under this scheme, John Phillips, who worked in Knysna from 1922 to 1927, went on to develop the first ecological critique of South African forestry.\textsuperscript{17}


\textsuperscript{17} See Bennett and Kruger, ‘Ecology, Forestry and the Debate over Exotic Trees in South Africa’.
Afforestation played a central role in state policies for conserving water. Orthodox forestry theories inherited from the mid-1800s posited that trees encouraged rain, stopped erosion, and regulated a more even flow in the streams. In the twentieth century, heterodox forestry researchers, such as Phillips, and prominent scientific and public critics challenged this view, culminating in the debate at the fourth British Empire Forestry Conference held in South Africa in 1935. Despite dissent, the view that trees had a positive influence on the water balance dominated forest policy from the 1880s (the foundation of state forestry) until the late 1940s, when research initiated at Jonkershoek Forest Research Station began to provide evidence that trees did in fact use more water than indigenous grasses and fynbos. Findings from this research led to the development of a national system for regulating afforestation. This new framework sought to balance the competing interests of different groups in order to achieve sustainable and equitable economic, environmental and social outcomes.

Environmental constraints, biological introductions and ecological change

South Africa is poor in forest resources compared with many other places in the world. Less than 0.3 per cent of its land area is covered with closed-canopy forest and only a small fraction of the country receives more than about 750 mm of rain per year, the amount necessary to profitably produce timber: given other physiographic and economic constraints, only about 2–3 million ha—no more than about 2.5 per cent of the land area—is suitable for forestry.


19 The question of whether Africa had or has adequate resources is inherently tied to our understanding of the history and potential productivity of African ecosystems; these views were also shaped by state and scientific attitudes towards indigenous land use in the recent past. For much of colonial history, foresters believed that African ecosystems, such as savanna, were denuded forests destroyed by indigenous people and early European settlers. Observers in South Africa began to challenge this view vigorously from about 1900 onward. More recently, social scientists have drawn upon science and history to critique foresters for ‘misreading’ landscapes. See J. Fairhead and M. Leach, Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic (Cambridge: Cambridge University Press, 1996); for southern Africa, see K. B. Showers, Imperial Gullies: Soil Erosion and Conservation in Lesotho (Athens, OH: Ohio University Press, 2005). Though foresters indeed often misread landscapes and ecosystems, the fact remains that given population growth and the ecological capacity of Southern African forests, resources scarcity would have become more pronounced. See F. J. Kruger’s book review of J. Tropp, Natures of Colonial Change in Britain and the World, 2 (2010): 263–70. This view is echoed in recent work on factor endowments in Africa. See G. Austin, ‘Resources, Techniques and Strategies South of the Sahara: Revising the Factor Endowments Perspective on African Economic Development, 1500–2000’, Economic History Review, 61 (2008): 587–624.
European colonisation, first in the Cape (1652 – early 1800s), and then later in the interior (post-1830s), provided the key catalyst that reshaped the ecology and economy of wood usage in Southern Africa, markedly accelerated by the mineral revolution from 1867 onward.

Within the Southern African context, scarcity created what James Beattie called ‘environmental anxieties’ that led settlers and scientists to use science to try to understand and control nature. A desire to overcome the inadequate forest resources drove Europeans to introduce hundreds of varieties of trees from the mid-seventeenth century to the mid-twentieth century. Anxieties about environmental constraints also explain the intense hope that tree planting could change southern Africa’s climate for the ‘better’. Government attempts to create a domestic sawmilling and timber plantation industry in South Africa sought to directly overcome the region’s biological (i.e. not enough valuable species) and ecological (i.e. not enough forests) deficiencies by importing and planting exotic species of pines, eucalypts and wattles.

Today, there are 750 species of exotic plants that are regarded as invasive in South Africa, the result of hundreds of years of human-mediated species introductions, which has had significant long-term impacts on the country’s economy, terrestrial ecosystems and scenery. We define ‘naturalisation’, which follows an initial species ‘introduction’, as a process that ‘starts when abiotic and biotic barriers to survival are surmounted and when various barriers to regular reproduction are overcome’. In short, when a species no longer needs human intervention to maintain, and potentially expand, a population. The next step in this process is ‘invasion’, when self-propagating populations spread to distant sites with or without human aid.

Historians have tended to view the broader process of species naturalisation and invasion as being a mix of accident, purposefulness, and innate ecological ‘fit’. This historiography lies in the long shadow of Alfred Crosby, who posited that Old World flora and fauna (what he called a ‘portmanteau biota’) succeeded in New World conditions because of evolutionary and historical reasons. Historians subsequent to Crosby have gone out of their way to eschew coherent interpretations of species movement, and have instead traced out geographic

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20 Beattie, *Empire and Environmental Anxiety*.
randomness of exchange.\textsuperscript{24} Others argue against Crosby by pointing out that the expansion of Australian \textit{Acacia} and \textit{Eucalyptus} globally negates his emphasis on the one-way expansion of Eurasian biota versus reverse flows from the New World to Eurasia, specifically Europe.\textsuperscript{25}

We seek to create a model for tree-species naturalisation and invasion in Southern Africa that accounts for multiple timescales and geographies without rejecting the importance of a theoretical explanation or falling into geographic determinism based on a single location. Introduction, naturalisation, and invasion required a broader ‘package’ of processes, including human disturbance of pre-existing ecosystems, exotic species introductions, and the purposeful and accidental creation of novel ecosystems.\textsuperscript{26} Successful naturalisations and invasions were not entirely random, nor did they occur at the same rate throughout the periods being discussed. Purposeful human actions served as the means for creating conditions necessary for most naturalisations and invasions to occur.\textsuperscript{27} It took, for instance, over half a century for people to find \textit{Eucalyptus} species that were adapted to tropical climes in Africa and Asia. The seeming ‘one-off’ success, such as \textit{Acacia mearnsii} in the midlands of Natal, was not random; trees only became invasive threats \textit{after} foresters and plantation owners planted them widely once they had recognised their superior performance in comparison with other \textit{Acacia} species propagated in South Africa (e.g. \textit{Acacia decurrens}, and \textit{A. dealbata}); even then, populations required human intervention to create ideal growing conditions by controlling competing indigenous vegetation and managing pests in plantations.

From 1652 to the 1880s, residents in Southern Africa did not develop a specific methodology for selecting species of exotic trees to plant; instead they relied on word of mouth and examples of successful trees that could be found about the landscape. Prior to the 1880s, would-be tree planters had very little knowledge about the climatic requirements of exotic trees. They had no methodology for determining what tree species would succeed except through the process of trial and error based on extensive trials—in effect a random process. During this period, human agency helped to establish almost all populations of exotic trees.


\textsuperscript{26} This was Crosby’s bigger point, which has been overlooked by most critiques of his work which cast him as arguing for a supposed European dominance of species exchange.

Humans propagated many of the most aesthetically valued or otherwise useful species (e.g. European Oak, *Quercus robur*, or the Grey Poplar, *Populus canescens*) through purposeful planting and management. Only a handful of introduced species formed self-reproducing populations that spread without human aid into undisturbed ecosystems (e.g. *Pinus pinaster* in the south-western Cape; *Salix* spp. throughout the river systems). In the instance of *P. pinaster*, invasion followed extensive plantings and broadcast sowings.

A massive boom in tree planting occurred in the second half of the nineteenth century because of the need for wood, geographic dispersal of settlers, and increased immigration of white settlers who were buoyed by the belief that trees could increase rain and change the climate. They had access to new species, many from Australia, that they believed would grow quickly to produce valuable, useful trees. Yet this enthusiasm faded as the exotic seeds and saplings failed to grow into forests; those that did seemed to have little influence on the climate; and some people began to even fear that the trees that did grow used more water than indigenous vegetation.

The onset of state forestry in the Cape Colony in the early 1880s occurred at the peak of this speculation. Foresters began to note that the species that proved successful were planted in Southern African climates similar to those in which they grew in their native habitats. This insight led to explorations that sought to find regions of the world with similar climates to those in Southern Africa, and to select trees from those regions to test in Africa. David Ernest Hutchins, a leader of this movement, told foresters to ‘fit the tree to the climate’, a mantra that guided foresters in the region for the entire twentieth century. By the 1940s, new insights into genetics allowed foresters to pinpoint the provenance of the most ‘superior’ trees growing in Southern Africa; botanists and foresters then went to foreign localities to find elite breeds to bring back to South Africa for trial and selection. As a result, foresters introduced species with traits and evolutionary histories most likely to naturalise in South Africa.

The expansion of plantations themselves caused new environmental constraints as well as afforded conservation opportunities. Timber plantations increasingly became implicated in a debate about water conservation and later, invasion biology. Since the second half of the nineteenth century some white settlers and scientists argued that exotic trees used more water than indigenous vegetation types. Eucalypts and wattles, in particular, were perceived to be water-demanding species that could dry *vleis* (swamps), small streams, and springs. Over time these concerns grew into a national debate about the effects of tree planting that peaked in the mid-1930s. At the same time, a small but engaged and powerful group of botanical enthusiasts in the south-western Cape began in the 1930s and 1940s to call for the removal of exotic trees from unique, diverse indigenous vegetation types, first the ‘Cape flora’ (now known as fynbos)
and later from other types. Many foresters sympathised with these concerns, and in 1945, Christiaan Wicht chaired the country’s first major report on the conservation of the fynbos, which emphasised the problem of invasive trees.28

Foresters believed that the positive benefits of plantations outweighed the negative, at the same time that they agreed that exotic trees had some negative side effects. They argued that timber produced in plantations allowed foresters to protect indigenous forests. That South Africa’s indigenous forest cover stayed essentially the same, or grew, throughout the twentieth century is chiefly attributable to state and private plantation timber output. Whether or not exotic trees used more water than indigenous plants and vegetation types was a question that would not be settled until the late 1940s. By the late 1960s, foresters began devising methods for managing invasive species as well as streamflow in catchments using controlled fires.29 This activity fit with the active ethos of foresters, inherited from the first generation of state foresters who saw South Africa’s environmental constraints and conditions as something to be understood, manipulated, and controlled for human benefit.

The origins, history and development of hydrological research in South Africa

South Africa is by no means the only region where people debated the hydrological and climatic influence of forests, but it is undoubtedly one of the most important places, if one judges in terms of the longevity and intensity of the debate, and the knowledge produced solving it.30 Given South Africa’s limitations in terms of wood and water it is unsurprising that a conflict arose, yet what makes the South African experience significant is the sustained national efforts that went into defining and attempting to solve this question.

South Africa’s post-1998 forest and water policies differ significantly from their pre-1998 antecedents, yet cannot be understood without reference to the period before 1998. Prior to 1998, legislation and policy frameworks did not discriminate against planted forests as a land use at the national level, something the current policy framework does. Rather, South African policies from the 1960s to the mid-1990s were predicated on the assumption that the permitting of afforestation and hence, indirectly, the allocation of water rights

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29 Pooley, *Burning Table Mountain*, 90.
should be determined regionally, as well as in relation to geographical patterns of water supply and demand and the economic efficiency of water users. This framework was situated within a broader catchment conservation strategy, which stipulated that the vast majority of state ‘forest land’ remain un-forested and the protection of catchments on privately owned land would be managed by the Department of Forestry through the Mountain Catchment Areas Act of 1970, while an amended Forest Act allowed for the regulation of afforestation through a permit system. This legislation and framework guided national forest and water policies in catchment until new national legislation and regulatory frameworks were established from the late 1980s to the late 1990s during the decline of the apartheid government and the emergence of post-1994 democracy in South Africa.

The transition from apartheid to democracy in South Africa significantly changed the structure of institutions, policies, and legislation for managing the environment. The Department of Forestry experienced some of the greatest changes, which began in the 1980s and early 1990s in response to economic and political changes within South Africa that encouraged the central government to corporatise plantations, merge, and shed responsibilities to provincial governments. The Department of Forestry went from controlling the country’s catchments and managing the biodiversity and invasive species on this formerly extensive state forest land—which totalled over 2 million hectares—to having little role in these areas today. Recent studies have shown how Department of Forestry researchers from the late 1960s to the late 1980s used research to create a coherent policy for using prescribed burns to control invasive species, maintain biodiversity and conserve water. The financial decline of the apartheid government in the late 1980s led to the fragmentation of this national policy, leaving an institutional and policy vacuum that is still largely unfilled, even after the establishment of Working for Water in 1995. In a recent article, the historian Simon Pooley concludes, ‘What remains tantalizing is what the longer term environmental outcomes might have been if the collapse of the apartheid state had not truncated the state conservation forestry research and management program in South Africa in the early 1990s’.

One of the key missing pieces from recent historical research and critical assessments of South Africa’s current environmental policies is an understanding of how South Africa’s forest and water conservation policies developed across

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33 Pooley, ‘Recovering the Lost History of Fire’, 76.
the twentieth century. To fill this gap, this book offers an historical examination of the origin and evolution of South Africa’s forest and water policies from the 1920s to the present. We pay particular attention to the history of South Africa’s first hydrological research station located in the Jonkershoek Valley near Stellenbosch. The Jonkershoek Forest Influences Research Station, as it was originally called,34 was the centrepiece of South Africa’s forestry research in relation to water conservation from the mid-1930s to the mid-1990s. The Forestry Division of the Union of South Africa founded the station in 1935 in order to resolve a deep-seated national debate about the hydrological impact of exotic trees. Research from the Jonkershoek station, especially that of its first director, Christiaan Wicht (hereafter Wicht), played a critical role in shaping South African policies surrounding forestry and water conservation from the mid-1930s until today.

Debates about the hydrological influence of afforestation in Southern Africa began in the second half of the nineteenth century, but only came to the forefront of national attention after 1902 as a result of different rural development drives following the South African War (1899–1902), the First World War (1914–1918) and the extensive rural resettlement of poor whites pursued first by Jan Smuts and later by J. B. M. Hertzog.35 These schemes all emphasised the importance of irrigation farming. The establishment of new irrigation schemes and farms, especially in the eastern Transvaal, created new claimants on water supplies who saw large-scale afforestation as a threat, rather than a means to an improved water economy. Criticisms of afforestation grew proportional to the expansion of plantations, which increased in size in the late 1920 and early 1930s just as Hertzog’s policy of resettling whites on forest settlements in the Cape, Natal, and Transvaal provinces began to take real effect.

Initial steps to acquire a site for the purpose of ‘forest influences’ research began in 1932, with the purchase of land in the Jonkershoek Valley, eight kilometres south-east of the university town of Stellenbosch. In 1935, the Forestry Department established a ‘forest influences’ research station there and work on the research program began after the resolution of the fourth British Empire Forestry Conference, held in South Africa that same year. The conference provided the imprimatur to the idea of such a program, which itself was the culmination of a series of attempts to gather evidence about afforestation effects, beginning with the catchment experiment set up in the eastern Transvaal at Jessievale in 1910. The conference affirmed the political and scientific urgency of the research, paving the way for foresters to commit proper resources to the

34 It was later called the Jonkershoek Forest Research Station, and then the Jonkershoek Forestry Research Center.
35 Concerns prior to the war focused on particular colonies or metropolitan areas. See Pooley, Burning Table Mountain, Chapter 3.
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program. Jan Smuts and the ecologist John Phillips articulated a comprehensive list of science and policy objectives to be satisfied through research, and again, these views gave the justification that allowed researchers to address questions beyond the narrow concern of the water issue, as was the case in the Jessievale design, opening the door to an inclusive ecosystems approach. As a result, the vision for research at Jonkershoek was broad and inclusive.

Jonkershoek was a central piece of what Saul Dubow describes as the ‘South Africanisation’ of science after the South African War (1899–1902). The two decades following Union in 1910 saw the progressive, intentional assembly of a body of scientifically trained foresters with advanced degrees from leading European and American universities, meant to augment and diversify the small though tenacious cadre of colonial foresters. Foresters shared a common purpose of creating a distinctly ‘South African’ science based on the construction of a unique white South African identity that stressed the importance of understanding environmental problems from a distinctly local, South African perspective. This belief was grounded in the desire to create a distinct national identity, and also reflected the economic imperative to build a modern, industrial South African economy. Foresters believed that the hydrological question of afforestation required a broader understanding of other problems within the fields of botany, ecology, physiology, meteorology, forest growth dynamics, timber mechanics, and economics. The Forestry Department sent forestry trainees to Dresden, Oxford, and Yale to receive training that was not available in South Africa following the closing of the forestry school at Tokai, as discussed further in Chapter 3.

Jonkershoek acted as a key locale in the national and international history of hydrology. Its location close to Stellenbosch University and the University of Cape Town enabled the ready exchange of ideas that Wicht needed as he worked to solve technical methodological problems, which required the help of experts from diverse disciplines to assist him, as he confronted the problems of running large experiments in difficult terrain and unpredictable climate. He designed a multiple-catchment experiment that sought to accommodate physiographic complexity and to unravel how secular climate change influenced catchment hydrology. This multiple-catchment design faced criticism from world-leading experts in hydrology, but ultimately became the basis for South Africa’s national hydrological research agenda.

Research produced by scientists at Jonkershoek and satellite stations informed a coherent national policy of catchment management and informed ecosystems management more generally. Wicht and his successors used findings from Jonkershoek to guide the expansion of afforestation while trying to balance the needs of downstream water users, including farmers, urban areas, and indigenous ecosystems. The hallmark of this system was a vision of consensus and nation-building that brought together disparate, often competing groups to direct the national economy by recognizing the diverse needs of constituent regions and stakeholders.

Jonkershoek was the seed of a bigger program. The work had hardly begun before a reconnaissance party had scouted the Drakensberg Mountains on foot and horseback, and selected Cathedral Peak as the next site to complement Jonkershoek. But Jonkershoek was much more than just the origin, it was the methodological test-bed for the program as a whole that eventually included experiments in all the forestry regions that tested the main plantation species and diverse catchment management regimes.

We contextualize the wider significance of the research and policies that flowed from Jonkershoek. There has been a tendency in current policies to reduce Jonkershoek’s findings to the key concept that exotic trees use more water than many indigenous vegetation types. The policy recommendations based on research findings from Jonkershoek must be understood as having been implemented within a national water and forest management strategy that sought to account for a variety of forms of land usage, including forestry, agriculture, and indigenous ecosystem conservation. National policy regarding forests and water from the late 1940s onwards, directed by findings from the network of catchment experiments that began at Jonkershoek, sought to direct afforestation to areas with higher rainfall and profitability, where there was little competition for water use, while encouraging catchment management on public and private lands through various Acts and policies. These policies led to the development of a coherent and effective national policy for managing catchments that was deconstructed from the late 1980s to the late 1990s. Current policy and public discourse on water resources have, by contrast, reduced the issue to one of governing the distribution of water-use rights among competitors and overlooking the sustainable management of catchments as ecosystems.

We conclude by analyzing the vicissitudes of the hydrology program during a period of political uncertainty lasting from the late 1980s to the late 2000s. The research station was transferred, along with the South African Forestry Research Institute, to Forestek within South Africa’s Council for Scientific and Industrial Research, CSIR, where it resided from 1990 to 1995. Since 1995–1996, funding has come mainly from the Water Research Commission on the basis of competitive bids. The Jonkershoek program remained alive after direct
government funding ended in 1995 owing to the efforts of a small, dedicated group of scientists who kept the research station going, and now shows the signs of revival, under new auspices. The infrastructure of the network, a large body of knowledge, and the core of an intellectual capital are a legacy now being rebuilt under the current rubric of global climate change: the South African Environmental Observation Network, a new initiative, is resuming elements of the monitoring.