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International Review of Environmental History is published by ANU Press

The Australian National University

Acton ACT 2601, Australia

Email: anupress@anu.edu.au

This title is available online at press.anu.edu.au

ISSN 2205-3204 (print)

ISSN 2205-3212 (online)

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Cover design and layout by ANU Press

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The Centre for Science in Society at Victoria University of Wellington provides funding to the journal for an editorial assistant. The Centre for Environmental History at The Australian National University supports the journal, and ANU Press publishes a free electronic version and a print-on-demand hard copy of the journal.

Our open-access policy means that articles will be available free to scholars around the world, ensuring high citation rates and impact in and beyond the field of history.

About the Journal

International Review of Environmental History takes an interdisciplinary and global approach to environmental history. It publishes on all thematic and geographical topics of environmental history, but especially encourages articles with perspectives focused on or developed from the southern hemisphere and the 'global south'. This includes but is not limited to Australasia, East and South East Asia, Africa and South America.

International Review of Environmental History's editorial board includes historians, scientists and geographers, as well as scholars from other backgrounds, who work on environmental history and related disciplines, such as ecology, garden history and landscape studies. The methodological breadth of *International Review of Environmental History* distinguishes it from other environmental history journals, as does its attempt to draw together cognate research areas in garden history and landscape studies.

The journal's goal is to be read across disciplines, not just within history. We encourage scholars to think big and to tackle the challenges of writing environmental histories across different methodologies, nations and timescales. We embrace interdisciplinary, comparative and transnational methods, while still recognising the importance of locality in understanding these global processes.

The Editor of *International Review of Environmental History* is happy to consider future special issues focusing on themes drawn from conferences or collaborations.

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Please send article submissions or abstracts to the Editor, Associate Professor James Beattie, The Centre for Science in Society, Victoria University of Wellington, P.O. Box 600, Wellington 6142, New Zealand. Email: james.beattie@vuw.ac.nz

Abstracts should be no more than 200 words, and include a list of keywords. Articles should be in the range 5,000 to 8,000 words (including footnotes), although longer submissions may be considered after consultation with the Editor.

Style and referencing: please use footnotes in Chicago style, and follow Australian spelling. For more details on Chicago style, please see: www.chicagomanualofstyle.org/tools_citationguide.html

The journal also accepts letters and short 'think pieces'. Please contact the Editor for further information.

INTRODUCTION

JAMES BEATTIE

The Centre for Science in Society,
Victoria University of Wellington;
Research Associate, Centre for Environmental History,
The Australian National University;
Senior Research Associate,
Faculty of Humanities, University of Johannesburg

The second issue of 2019 has a contemporary feel, at least to an editor who's an environmental historian largely of the nineteenth century! The themes the articles explore relate to chemical pollution, biofuel production, climate misinformation, gender, race and hunting, and historiographical interpretation.

In **'A silenced spring? Exploring Africa's "Rachel Carson moment": A socio-environmental history of the pesticides in tobacco production in Southern Rhodesia, 1945–80'**, Elijah Doro and Sandra Swart examine the environmental impacts of increasing agricultural commercialisation and pesticide use on the farmers of Southern Rhodesia (present-day Zimbabwe). Doro and Swart place the experience of Zimbabwe's tobacco farmers in the context of 'slow violence', the 'environmentalism of the poor' and 'environmental racism', in the process revealing the local divergence of experience of chemical pollution in relation to the global environmentalism sparked by Rachel Carson's *Silent Spring*. Carson, it should be noted, never applied her analysis to Africa. The article presents an important and original perspective on the intertwined environmental and human impacts of modern, industrial agriculture.

In part 2 of her series exploring European exploitation of African energy resources, Kate B. Showers examines **'Biofuels' unbalanced equations: Misleading statistics, networked knowledge and measured parameters: Part 2. Networks, consensus and power'**. Critiquing the imprecision of large-scale, generalised datasets to guide policy, Showers powerfully challenges claims about biofuels modelling. She shows that 'globalised data sets, databases and models ... reinforce and amplify the biases and world views of the professional networks that created them.' They are, in fact, she notes, greatly divorced from local realities. Instead, Showers argues that biofuels policymaking reliant on local-scale models that recognise diversity can have a real benefit for peoples and communities.

Susan E. Swanberg's article provides a connection between contemporary theoretical paradigms of science misinformation and historical debate on climate change. In **"The Way of the Rain": Towards a conceptual framework for the retrospective examination of historical American and Australian "rain follows**

the plow/plough” messages’, she offers a fascinating analysis of ‘rain follows the plough’ (the scientifically incorrect idea that ploughing increases local rainfall), and the insight that historical case study might provide as ‘a basis for the analysis of historical science messaging’. By analysing the development, reception and processing of ‘rain follows the plough’, Swanberg proposes a framework that can be applied ‘to historical instances where the public understanding—and application—of science was hindered by factors modern researchers study in their empirical work’.

Remaining in the nineteenth century, Vijaya Ramadas Mandala provides a revisionist account of hunting by elite British women in India during the 1830s and 1840s. **‘Tiger huntresses in the Company Raj: Environmentalism and exotic imaginings of wildlife, 1830–45’** is an analysis informed by class, race and gender, which demonstrates the greater social opportunities sometimes afforded to elite women by life in Britain’s colonies. Mandala also explores the environmental perception of British female hunters, and describes the context of their experiences amidst a changing environment and growing British power over Indian nature, most notably through the extension of state forests. This is a work that highlights the need for more gendered analyses of environment and empire.

In the final article, a ‘think piece’ on **‘Adam Smith, natural extraction and historical judgement: An unwarranted environmental legacy’**, James Cullis reassesses environmental historians’ interpretation of Adam Smith’s writings on the natural world. Through a close reading and contextualisation of Smith’s works, Cullis argues that Smith’s original views on the exploitation of nature must be understood within his theory of societal progress in stages, rather than necessarily being interpreted as the harbinger of market-driven exploitation of nature. Cullis observes that ‘Smith’s attitude towards mining, as revealed in his writing, reveals a scepticism with regard to the profitability and necessity of such action’.

Call for papers

I particularly encourage submissions on topics related to history and energy, the atmosphere and water, especially in relation to Africa, South America and Asia. Please also contact me if you are interested in guest editing a special issue.

Acknowledgements

I am indebted to the support of so many in making this publication possible. *International Review of Environmental History* is published with the support of the Centre for Environmental History and The Australian National University. Its former Director, Professor Emeritus Tom Griffiths, has enthusiastically backed this venture from the outset. In 2013, Professor Bruce Clarkson, formerly Director of the Environmental Research Institute, University of Waikato, granted me the time to devote to planning and preparing the journal by giving me teaching buy-out. I am especially grateful to the journal's Associate Editors and supportive and active Editorial Board for permitting me to test ideas and share material with them. Further support for the journal has also come through funding provided by the Centre for Science in Society, Victoria University of Wellington. Finally, I acknowledge the assiduous copyediting of Dr Austin Gee.

James Beattie, Editor,
Dunedin, September 2019

A SILENCED SPRING? EXPLORING AFRICA'S 'RACHEL CARSON MOMENT': A SOCIO- ENVIRONMENTAL HISTORY OF THE PESTICIDES IN TOBACCO PRODUCTION IN SOUTHERN RHODESIA, 1945–80

ELIJAH DORO AND SANDRA SWART

History Department
Stellenbosch University

Abstract

Rachel Carson's impact on the modern environmental movement is widely debated, but her 'African moment' has only received cursory historiographical attention. Environmental historians have not yet unpacked how her ideas have been appropriated, applied and contested in the continent, beyond the recent pejorative description of Carson as a 'killer of Africans'. This paper uses the lens of political ecology and environmental history, drawing mainly primary sources from the National Archives of Zimbabwe, to interrogate the use of pesticides in tobacco farming in Southern Rhodesia (now Zimbabwe) from 1945 to 1980, and their effects on the human body, the body politic and the natural environment. It traces the growth of pesticide use beginning with the end of the Second World War, which saw a turning point in the global pesticides' regime as crop chemicals such as DDT became widespread. It explores the problems that arose with the use of these pesticides and connects this narrative with the various global debates on 'environmentalism' that arose in the 1960s, and how this impacted on the evolution of legislation and policies to curtail pesticide use in tobacco production in Southern Rhodesia. In doing so, the paper constructs a contextual reading of *Silent Spring* within Southern Rhodesia and argues that despite the neglect of Carson within the tradition of African environmental historiography, her ideas significantly shaped the emergence and growth of modern environmentalism within the continent.

Keywords: environmentalism, DDT, Rachel Carson, pesticides, tobacco, Southern Rhodesia, Zimbabwe, Africa

Introduction

In 1962, Rachel Carson, an American marine biologist, penned *Silent Spring*, a highly controversial book that revolutionised global perceptions of the widespread use of pesticides and chemicals in agricultural production.¹ In this book, Carson critiqued conventional views of organochloride persistent pesticides, particularly DDT and their toxic effects on ecological systems, as well as plant and human life. She portrayed a dystopian civilisation teetering on the brink of self-imposed extinction because of the contamination of the air, rivers, forests and sea with chemical sprays that ‘lie in the soil, entering into living organisms, passing from one to another in a chain of poisoning and death’.² *Silent Spring* became a contentious and contested text that put pesticide use within the domain of public debate and environmental policy globally. Although initially maligned by the defenders of the pesticide and chemical establishment, the book precipitated our contemporary discourse and debates over the ecological dimensions of pesticide use.³ *Silent Spring* galvanised environmental activism and public policy in most countries⁴ as the problem of pesticides gained public notoriety and slowly became a subject of enquiry investigated by environmental scientist and, even more slowly, environmental historians.⁵ However, concerning tobacco production, *Silent Spring* was reticent, noting only as an aside the permanent poisoning of the soil by tobacco chemicals.⁶ This silence caused ‘Big Tobacco’ to receive the book less critically and even embrace it, as they had feared an overt critique might draw attention to the industry’s own massive use of pesticides.⁷

1 Rachel Carson, *Silent Spring* (London: Hamish Hamilton, 1963).

2 *ibid.*, 5.

3 The book was heavily attacked by the defenders of the pesticide industry as being unscientific and an hysterical, apocalyptic fantasy. Environmental revisionists like David Ropeik also blamed her for fostering a set of accepted beliefs that actually caused much damage to the human and natural environment, blogs.discovermagazine.com/collideascape/2012/06/22/the-lessons-and-echoes-of-silent-spring/#.WzvC-RaxWEC, accessed 5 July 2018.

4 It is important to note that even before *Silent Spring*, environmental issues were already being made visible in public policy from the late 1950s by several other writers and practitioners in the global North. This movement, however, was not firmly entrenched, and it was Carson who gave much impetus to this wave. These early writers include the British–South African Sir Solly Zuckerman, who coined the term ‘environmental science’ in 1959 and played a huge role in the establishment of the UK Natural Environment Research Council in 1964, and the American Lynton Caldwell who authored ‘Environment: A Focus for Public Policy’, in *Eikistics* 17, no. 102 (May 1964). See Paul Warde, Libby Robin and Sverker Sörlin, *The Environment: A History of the Idea* (Baltimore, MD: Johns Hopkins University Press, 2018), 18–20.

5 Also see *DDT, The Silent Spring and the Rise of Environmentalism: Classic Texts*, ed. Thomas R. Dunlap (Seattle, WA: University of Washington Press, 2008); Frank Graham, *Since Silent Spring* (London: Hamish Hamilton, 1972); Andrei Vinogradov and Stanislav Petriashin, ‘Chemical Industry, the Environment and Russian Provincial Society: The Case of Kokshan Chemical Works, 1850–1925’, *Ambix* 1, no. 26 (April 2018): 1–26, doi.org/10.1080/00026980.2018.1451451.

6 Rachel Carson discusses how tobacco chemicals then widely used in the United States, such as arsenic and benzene hexachloride, contaminate the soil and make it toxic for food crops such as carrots and sweet potatoes.

7 Standard Schaeffer, ‘The Greening of Big Tobacco’, *Counterpunch Magazine*, counterpunch.org/2007/12/15/the-greening-of-big-tobacco/, accessed 10 July 2018.

Was there an African Rachel Carson? No, but Africa had its 'Rachel Carson moment(s)', as this essay will show. Despite this, however, as well as over 50 years of considerable historical analysis of pesticides in the United States and the global North, Africa has been neglected—there is a strange historiographical lacuna. Perhaps this omission could be explained by the distinctive quantitative disparities in pesticide use between the global South and North. The World Health Organization (WHO) estimates that despite rising use since the 1940s, the global South only consumes 25 per cent of total global pesticide production, while the North consumes a disproportionately higher 75 per cent.⁸ More worryingly, however, and ironically within the context of the historiographical lacuna, 99 per cent of deaths due to pesticide use occur in the global South!⁹ This inevitably begs the question whether *Silent Spring* represents a form of only European and Anglo-American environmentalism, which has been simply *projected* as a global movement. Is it because *Silent Spring* pontificates from the lofty parapets of a technologically modernistic, racially privileged society and fails to appeal to similar chemical, calamitous tragedies and disasters in the developing world that largely affect marginalised racial groups such as blacks, Asians and Latinos? This profoundly racially tinged accusation is, of course, a reminder that modern environmentalism is in itself the progeny of Western post-war cultures of prosperity and consumerism that ignited concerns about quality of life and other aesthetic values to which the natural environment became a public good, and which rested on perceptions of nature as being an entity somehow separate from humans.¹⁰ This classed and raced identity of modern environmentalism has resulted in Carson's work not being fully appreciated or even investigated more robustly in the global South.¹¹ Moreover, once a new wave of iconoclastic scholarship on environmental histories emerged in the 1990s, the universalism of environmentalism was challenged and a call was issued for more contextualised and nuanced interpretations.¹² These scholars argued that Northern environmentalism is not relevant to poor countries because of different development paths taken as well as differences in economic strength, sociopolitical structures and cultural attitudes between North and South explained (crudely) by poverty and weak democratic systems.¹³ Under the banner of 'environmental

8 www.who.int/ceh/capacity/Pesticides.pdf, accessed 25 February 2019.

9 'Communities in Peril: Global Report on Health Impacts of Pesticide Use in Agriculture', Pesticide Action Network (September 2010), www.pan-germany.org/download/PAN-I_CBM-Global-Report_1006-final.pdf, accessed 25 February 2019.

10 Gary Kroll, 'The Silent Spring of Rachel Carson: Mass Media and the Origins of Modern Environmentalism', *Public Understanding of Science*, 10 (2001): 403–20.

11 Shawn Miller, *An Environmental History of Latin America* (Cambridge: Cambridge University Press, 2007), 206.

12 Most outstanding in this regard is the work of Ramachandra Guha and Joan Martinez, which rejects a universal theory of modern environmentalism and contends that there are two different traditions of environmentalism for the North and South, all based on their unique historical trajectories. See Ramachandra Guha and Joan Martinez, *Varieties of Environmentalism: Essays North and South* (London: Earthscan, 1997), 12.

13 Miller, *An Environmental History of Latin America*, 206.

justice', this scholarship further criticised the unfair and disproportionate impact of environmental policies along the lines of race, colour and class, even within the global North.

This critical scholarly tradition seems to have evoked the derision for Carson in Africa and in the global South, where environmentalism has struggled to connect with the historical problems of poverty, inequality and the legacy of colonialist and racist environmental violence. The ecocentrism of Carson's *Silent Spring* has been viewed by anthropocentric environmentalists as diametrically opposed to the more human-oriented environmentalism appropriate for Africa and the global South.¹⁴ Contemporary critics of her work have even called her a 'mass murderer' responsible for the death of millions of Africans from malaria due to her hyperbole and apocalyptic alarmism, which led the WHO to suspend the Global Malaria Eradication Program in 1969 and to stop funding anti-malaria spray programs in Africa.¹⁵ This program had started in 1955 and was discontinued directly as a result of the global outcry instigated by *Silent Spring* about the cumulative effects of DDT on the ecosystem. However, African governments still remain opposed to the global 'ban' on DDT.¹⁶ This background has clouded a critical understanding and historical reading of Carson in the contextualised realities of Africa, where *Silent Spring* has been approached by most critics of ecocentrism with a hostility almost amounting to hyperbolic.¹⁷ This polemicisation springs from the tension between what Ramachandra Guha and Joan Martinez have termed 'full stomach and empty belly environmentalism'.¹⁸ Implicit in this dichotomisation is the racial legacy it reveals within the context of Africa's colonial history of racial domination, exploitation and subjugation. Subsequently, 'full stomach environmentalism' has

14 See Paul Driessen, *Eco-Imperialism: Green Power, Black Death* (Bellevue, WA: Free Enterprise Press, 2003). Driessen attacks the ecocentric environmental lobby groups from the global North that value wildlife and ecology above human lives. He also further questions the scientific pedigree of the DDT claims in *Silent Spring*.

15 David Kinkela, *DDT and the American Century: Global Health, Environmental Politics and the Pesticide that Changed the World* (Chapel Hill, NC: University of North Carolina Press, 2011), 145. Also, US Senator Tom Coburn declared in 2007 that 'millions of people, particularly children under five, died because governments bought into Carson's junk science claims about DDT'. The bestselling novelist Michael Crichton in one of his novels, titled *State of Fear*, blames Carson for the DDT ban that 'killed more people than Hitler', and he puts the death toll at 50 million. See e360.yale.edu/features/rachel_carsons_critics_keep_on_but_she_told_truth_about_ddt, accessed 26 February 2019.

16 In July 2013, the heads of state and government of the African Union adopted a resolution calling for the continued use of DDT for malaria eradication in the continent despite mounting concerns from some environmentalists in the global North.

17 As a result of propaganda from critics of ecocentrism and other localised experiences, most African governments continue to use DDT for the control of malaria and they have criticised the ban as being irrelevant in Africa where malaria kills millions of people every year and is a more serious threat than DDT environmental contamination. In 1996 for instance, South Africa withdrew the use of DDT for malaria control and this resulted in a huge surge in malaria cases, forcing the country to revert to DDT. Data for global use of DDT between 2000 and 2014 reveal that of the 19 countries listed as still openly using DDT, 14 are in sub-Saharan Africa. See Henk van den berg et al., 'Global Trends in the Production and Use of DDT for Control of Malaria and Other Vector-borne Diseases', *Malaria Journal* 16, no. 401 (2017): 1–8, doi.org/10.1186/s12936-017-2050-2.

18 Guha and Martinez, *Varieties of Environmentalism*, 12.

been described as anti-human, elitist and driven by rich, white non-governmental organisation (NGOs) and wealthy nations that impose environmental agendas that are either irrelevant or actively harmful to Africa and black Africans.¹⁹

However, in this paper we argue that it is imperative to go beyond strident polemics and attempt an historically contextualised understanding of Carson in Africa since the concerns she raised have continued to permeate current debates on the use of pesticides in agricultural production and the attendant human and ecological cost in the global South. In the realm of tobacco farming, for example, Patricia Díaz Romo produced a 2011 documentary film that graphically portrayed the pesticide exposure of Huichol Indians who work as labourers in Mexico, exposing fatal poisonings, attendant poverty, vulnerability and reckless exploitation of labourers in the toxic zones that are Mexican tobacco farms.²⁰ There has also been increasing concern about the neuropsychiatric effects of pesticide exposure experienced by tobacco workers, with reports of incidences of depression and suicide linked to organophosphate pesticides.²¹ More revealing in that regard is a study on Brazil's tobacco farms that found 48 per cent of workers suffered from pesticide-related health problems.²² In Africa, the situation is equally disastrous. During a WHO public hearing on the Framework Convention on Tobacco Control in August 2000, a Kenyan member of parliament pointed out the scourge of pesticide use in tobacco farming in Africa and the impacts on poor black peasant farmers and the natural environment.²³ These include pesticide-related ailments, unexplained miscarriages, infant mortality and poisoned rivers.²⁴

19 Andrew Ross, *Strange Weather: Culture, Science and Technology in the Age of Limits* (New York: Verso, 1991), 207–12.

20 Patricia Díaz Romo, 'Huicholes y Plaguicidas' [Huichols and Pesticides], www.youtube.com/watch?v=-5k7Xg8JuMI, accessed 11 April 2018.

21 Thomas Arcury and Sarah Quandt, 'Health and Social Impacts of Tobacco Production', *Journal of Agromedicine* 11, no. 3–4 (2008): 71–81, doi.org/10.1300/J096v11n03_08.

22 R. M. Salvi et al., 'Neuro-psychiatric Evaluation in Subjects Chronically Exposed to Organophosphate Pesticides', *Toxicological Sciences* 72, no. 2 (2003): 267–71, doi.org/10.1093/toxsci/kfg034.

23 World Health Organization, 'Tobacco and Poverty: A Vicious Circle' (2004): 6. Kenya has approximately 55,000 tobacco-farming households. Despite the narratives of prosperity of the smallholders, research has revealed that these farmers are poor, vulnerable and exposed to dangerous chemicals. An epidemiological study revealed that 26 per cent of tobacco workers in the country suffered from pesticide poisoning: see G. J. A. Ohayo-Mitoko et al., 'Acetylcholinesterase Inhibition as an Indicator of Organophosphate and Carbamate Poisoning in Kenyan Agricultural Workers', *International Journal of Occupational Environmental Health* 3, no. 21 (1997): 195–200, doi.org/10.1179/oeh.1997.3.3.210. Also see Qing Ling et al., 'The Economic Geography of Kenyan Tobacco Farmers' Livelihood Decisions', *Nicotine and Tobacco Research* (2019): 1–4.

24 Statistics reveal that 86 per cent of global tobacco production is concentrated in the low- and middle-income economies (i.e. the global South) where the use of agrochemicals imposes severe health and socio-environmental problems on the poor populations engaged in production. See Natacha Lecours et al., 'Environmental Health Effects of Tobacco Farming: A Review of Literature', *Tobacco Control* 21, no. 2 (2012): 191–6, doi.org/10.1136/tobaccocontrol-2011-050318.

While there are several historical works on pesticides and pest control in Africa, most of these examine the problem from the perspective of colonisation of land and control of nature, particularly from an epidemiological perspective.²⁵ These studies focus on colonial pest control programs for diseases such as trypanosomiasis, rinderpest, malaria and sleeping sickness that became popular in the discourses of colonial conquest and development from the 1930s. However, they do not construct these histories within the narratives of environmentalism that were fashionable from the 1960s and put global scrutiny on some of the chemicals that were widely used for these large-scale pest and disease control projects.²⁶ There is also remarkably little research into southern Africa's historical reliance on pesticides. In particular, there has not been much research into the historical use of agricultural pesticides in Southern Rhodesia²⁷ and Zimbabwe.²⁸ In April 2018, Human Rights Watch released a report focusing on child labour and other human rights abuses in the tobacco farms in Zimbabwe.²⁹ Even this report only glancingly alluded to the risks of nicotine poisoning and exposure of farm workers to tobacco chemicals.³⁰ We thus take this report back in time by offering an historical survey of the pesticide problem and the pest control infrastructure in tobacco production since 1945 when pesticide use started gaining its global reputation. The major challenge, however, is that until the 1960s much of the conversation on the use of pesticides in agricultural production

25 These authors focus more on African colonial ecology, entomology and epidemiology and neglect pest control programs in agricultural production. See John Ford, *The Role of Trypanosomiasis in African Ecology: A Study of the Tsetse Fly Problem* (Oxford: Clarendon Press, 1971); John Mackenzie, 'Empire and the Ecological Apocalypse: The Historiography of the Imperial Environment', in *Ecology and Empire: Environmental History of Settler Societies*, ed. Tom Griffith and Libby Robin (Edinburgh: Keele University Press, 1997), 215–28. Also see James Giblin, 'Trypanosomiasis Control in African History: An Evaded Issue?', *Journal of African History* 31, no. 1 (1990): 59–80, doi.org/10.1017/S0021853700024786; K. A. Hoppe, *Lords of the Fly: Sleeping Sickness Control in British East Africa, 1900–1960* (Westport, CT: Praeger, 2003); Ian Scoones, 'The Politics of Trypanosomiasis Control in Africa', STEPS Working Paper 57 (Brighton: STEPS Centre, 2014).

26 Ford, although writing around 1970, simply provides a cursory mention of the use of these insecticides in pest control and argues that their effects were less durable than social control, but he ignores the environmental and public health debates about their use, which had gained momentum during this time.

27 Southern Rhodesia is modern-day Zimbabwe. The country gained its independence from white minority settler rule on 18 April 1980.

28 Existing literature is largely from the agricultural and environmental sciences and focuses on the contemporary challenges of pesticide use in production from a technical perspective. See Blessing Maumbe and Scott M. Swinton, 'Hidden Costs of Pesticide Use in Zimbabwe's Smallholder Cotton' (unpublished paper), American Agricultural Economics Association Annual Meeting, California, 28–31 July 2002; Hakan Berg et al., 'DDT and Other Insecticides in Lake Kariba Ecosystem', *Ambio* 21, no. 7 (November 1992): 444–50; Allen Mbanda and Mark Zaranyika, 'DDT Residue in Terrestrial Environment in the Mount Darwin–Rushinga Area: Zimbabwe', *Journal of Applied Science in Southern Africa* 7, no. 2 (2001): 83–96; Shepherd Ndlela, 'Phasing out Harmful/Hazardous Yet Effective Synthetic Insecticides: How Will the Tobacco Farmer Manage the Pesticide Intensive Tobacco Crop?', *TRB Technical Report* (April 2017).

29 Margaret Wurth, 'A Bitter Harvest: Child Labor and Human Rights Abuses on Tobacco Farms in Zimbabwe', *Human Rights Watch* (5 April 2018): 48–57.

30 The above report uses only oral interviews to look at the problem of nicotine and pesticide poisoning, thus relying exclusively on oral testimony not supported by documented cases of chemical poisoning. The interviews, though important as windows into the social life of tobacco farm workers, neglect the prevalence of nicotine and pesticide poisoning. Consequently, many of the conclusions reached are superficially circumstantial, and an epidemiological study might be necessary to validate the findings of the report.

generally reflected only utter obliviousness to the link between pesticides and the contamination of the human and natural environment. Consequently, official records and archival material afford us only scanty detail on the problem, and much that can be gleaned is from anecdotal data. This paper hopes to open the floodgates for more surveys in future to understand the environmental costs of using chemical pesticides in agricultural production in Southern Rhodesia. In attempting this reconstruction, we are led by the dictum of Donald Worster that as environmental historians we should tell a story of the past that discourages 'irresponsibility in the present'.³¹ Consequently, in telling this story, we invoke Carson's *Silent Spring*, reading it in an African context to show how the local and the global can interact within the broad spectrum of modern environmentalism—thus 'glocalising' and not 'globalising' *Silent Spring*.³² In taking the context of the global South seriously, this paper bridges the neglected study of Carson with the ongoing attempts to understand environmentalisms that do not fall into the typical model offered by the global North. Thus we engage with the concept of 'slow violence'—that is, ecological violence that unravels itself gradually, is subtly invisible and scattered in temporal space.³³ We also discuss the concept of the 'environmentalism of the poor', which looks at environmentalism through the perception of livelihoods, necessity and survival, as opposed to the 'environmentalism of the rich', which concentrates on aesthetics and quality of life.³⁴ We further extend the class-based concept of the 'environmentalism of the poor' into illuminating how racial identity also created biases that led to discrimination in environmental policies and practices and the construction of 'environmental racism' in colonial Africa.³⁵ In this sense, Filomina

31 Donald Worster, 'The Two Cultures Revisited: Environmental History and the Environmental Sciences', *Environment and History* 2, no. 1 (February 1996): 3–14, doi.org/10.3197/096734096779522446.

32 We use the term 'glocalisation' to denote a rejection of framing linear prescriptive global narratives around *Silent Spring*. Rather, we favour a more contextualised and ideographic framing based on a different set of social, economic and political local realities. This does not, however, delink the local from the global, but simply gives it a more comprehensible context. William Vogt's epoch-making book in 1948 *Road to Survival* (doi.org/10.1097/00010694-194901000-00018), written long before *Silent Spring*, was novel in its ability to illustrate this interconnectedness of global environmental histories and how local ecologies were integral to a larger global whole.

33 The concept of 'slow violence' caused by pesticide contamination and nuclear fallout is the chief motif in *Silent Spring*. For a more comprehensive conceptualisation of 'slow violence' see Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011), 2.

34 Guha and Martinez popularised the concept in the 1990s. Nixon captures the term as signifying a condition where a new official landscape is formally imposed on a vernacular one. A vernacular landscape is one that is integral to the socio-environmental dynamics of the community, and an official landscape denotes a bureaucratically rewritten landscape devoid of existing socio-environmental norms. For further readings on the concept see Joan Martinez-Alier, *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation* (Cheltenham: Edward Elgar Publishing, 2002).

35 The concept of environmental racism emerged from the 1960s during the American civil rights movement. It was connected to how race was at the heart of social policy in the urban environment where toxic waste was dumped in African-American areas, leading to widespread protests in the late 1970s. These protests led to the publication of a seminal report by the Commission for Racial Justice entitled 'Toxic Waste and Race', which concluded that race was the most definitive variable in the location of waste facilities even more than poverty. See Robert D. Bullard, *Confronting Environmental Racism: Voices from the Grassroots* (Boston, MA: South End, 1993); Clenora Hudson-Weems, 'Environmental Racism: Black Landowners, and the Making of a New Hilton Head—An Emmett Till Continuum', in *Environmental Justice in the New Millennium: Global Perspectives on*

Steady has underscored that 'environmental racism' is based on the 'structural expendability' of black Africans that is traceable to Western hegemonic proclivities derived from the history of the slave trade and colonialism in which Africans were reduced to 'no-humans' or subhumans to justify their oppression based on race and white privilege.³⁶ She further argues that the expendability of Africans and minority agricultural populations, built for many years on the basis of racial identity, still continues to shape the agenda of the contemporary neo-liberal global economy where African and Caribbean countries have been ruined by Northern chemical processes that destroy the environment and sustainable agriculture.³⁷ Although *Silent Spring* did not allude explicitly to race, class or any power dynamics, we will show that it strongly connects with the 'environmentalism of the poor', 'slow violence' and 'environmental racism' because of its passionate activism against the power of big chemical companies and their toxic hold on the American subalterns.³⁸ The colonial pest control programs in Africa were also much of a reflection of this intersection between science, power, race, ecology and politics, and this had significant leverage in shaping the intervention strategies and the impact on the human and natural environment.³⁹

In contemporary postcolonial Africa, environmentalism has continued to be defined through the perceptions of the west to the detriment of local capacities and conditions.⁴⁰ Robert Nelson identifies a tendency where, under the banner of saving the African environment, African people have been subjected to a new form of 'environmental colonialism', and environmental activism in Africa has come to exhibit a neocolonial character.⁴¹ Paul Driessen categorises the ideological environmental movement from the North operating in the global South as

Race, Ethnicity and Human Rights, ed. Filomina Steady (New York: Palgrave Macmillan, 2009), doi.org/10.1057/9780230622531_13; Filomina Steady, 'Environmental Justice Cross-Culturally: Theory and Praxis in the African Diaspora and in Africa', in *Environmental Justice in the New Millennium*, ed. Steady. In Africa and the global South, environmental racism involved the deliberate pollution of the environment and settlements with toxic chemicals, leading to death and disease, and the physical dislocation from the natural environment through forced removals. See M. F. Phakane and Filomina Steady, 'Nuclear Energy Hazardous Waste, Health, and Environmental Justice in South Africa', in *Environmental Justice in South Africa*, ed. David A. McDonald (Cape Town: University of Cape Town Press, 2002); Farieda Khan, 'The Roots of Environmental Racism and the Rise of Environmental Justice in the 1990s' in *Environmental Justice in South Africa*, ed. McDonald.

36 Steady, 'Environmental Justice Cross-Culturally', 49.

37 *ibid.*, 51.

38 Nixon, *Slow Violence and the Environmentalism of the Poor*, xi.

39 See Ford, *The Role of Trypanosomiasis in African Ecology*; and Scoones, 'The Politics of Trypanosomiasis Control in Africa', 11.

40 In most cases, pest control programs for public health in Africa are run and sponsored by NGOs from the global North who set the 'environmental agenda'. This agenda is usually influenced by global discourses and not vernacular experiences.

41 Robert Nelson, 'Environmental Colonialism: Saving Africa from Africans', *The Independent Review* 8, no. 1 (Summer 2003): 65–86.

constituting a form of 'eco-imperialism'.⁴² Within the context of all this, therefore, this paper hopes to contribute to the historiography of pesticide use in Africa and the framing of a more contextualised understanding of Carson's environmentalism within the global South.⁴³

The post-Second World War 'pesticide treadmill' and pest control in Southern Rhodesia, 1948–64

The Second World War saw a prodigious growth of the pesticide and chemical industry.⁴⁴ During the development of chemical formulas to use as agents of chemical warfare, a substantial number of chemicals were created and stockpiled that had lethal potency to both humans and insects. These chemicals were being manufactured by big chemical companies such as the Swiss-based Geigy company, which had subsidiaries in various countries in the global North such as England, Canada and the United States.⁴⁵ It was in the United States, however, that the chemicals industry grew most substantially to meet the demands of the war effort.⁴⁶ The production of these synthetic pesticides in the United States had reached 124,259,000 pounds in 1947.⁴⁷ When the war ended these chemicals slowly found wonder uses in agriculture where they were hailed as the saviours of mankind from pests and assumed an unparalleled global reputation. The most famous of these synthetic chlorinated hydrocarbons, dichlorodiphenyltrichloroethane (DDT) had been synthesised by a German chemist in 1864 but became well known as an insecticide in 1939. It was used extensively during the war to spray Allied soldiers against typhus in the Mediterranean and malaria in the tropics.⁴⁸ DDT catalysed an explosive revolution and expansion of the pesticide industry. This was largely a result of the lower costs and unprecedented effectiveness of the insecticide and other chlorinated hydrocarbon pesticides, which led to their widespread use in the

42 Paul Driessen, *Eco-Imperialism: Green Power, Black Death*. Also, Alfred Crosby uses the term 'ecological imperialism' to denote the changing face of vernacular ecologies as a result of European colonial settlement in North and South America, which introduced new human beings, new weeds, new animals, new pathogens and new diseases. See Alfred W. Crosby, 'Ecological Imperialism: The Overseas Migration of Western Europeans as a Biological Phenomenon', in *The Ends of the Earth: Perspectives on Environmental History*, ed. Donald Worster (Cambridge: Cambridge University Press, 1988), 111.

43 See also Hedley Twidle, 'Rachel Carson and the Perils of Simplicity: Reading *Silent Spring* from the Global South', *ariel: A Review of English Literature* 44, no. 4 (2014): 49–88, doi.org/10.1353/ari.2013.0028. This is, however, an eco-critical analysis and frames *Silent Spring* as more a literary text, deploying textual criticism for its analysis. Nevertheless, Twidle juxtaposes the work of Arundhati Roy and Carson in trying to understand how Carson's ideas of ecology and toxicity carry meaning in the global South.

44 Christopher D. Cook, 'The Spraying of America', *Earth Island Journal* 20, no. 1 (Spring 2005): 34–8.

45 O. T. Zimmerman and Irvine Lavine, *DDT: Killer of Killers* (Rochester, NY: The Record Press, 1946), 39.

46 Between 1943 and 1944, 15 American chemical companies were producing DDT and other chemicals for the armed forces.

47 Carson, *Silent Spring*, 14.

48 William Cronon, 'Silent Spring and the Birth of Modern Environmentalism', in *DDT, Silent Spring, and the Rise of Environmentalism*, ed. Thomas Dunlap (Seattle, WA: University of Washington Press, 2008), xi.

fields of agro-industry and public health.⁴⁹ The result of this monumental success was the expansion of the pesticide industry in general, which was so widespread and rapid that it ‘steamrolled’ pest control technology as chemical pest control expanded in scale.⁵⁰ As development experts came to put their faith in the power of science and American capitalism to modernise backward communities in the post-war years, the large-scale use of DDT in the global North was replicated in the global South as an important technology ‘to break the cycle of poverty, malnutrition and disease’.⁵¹

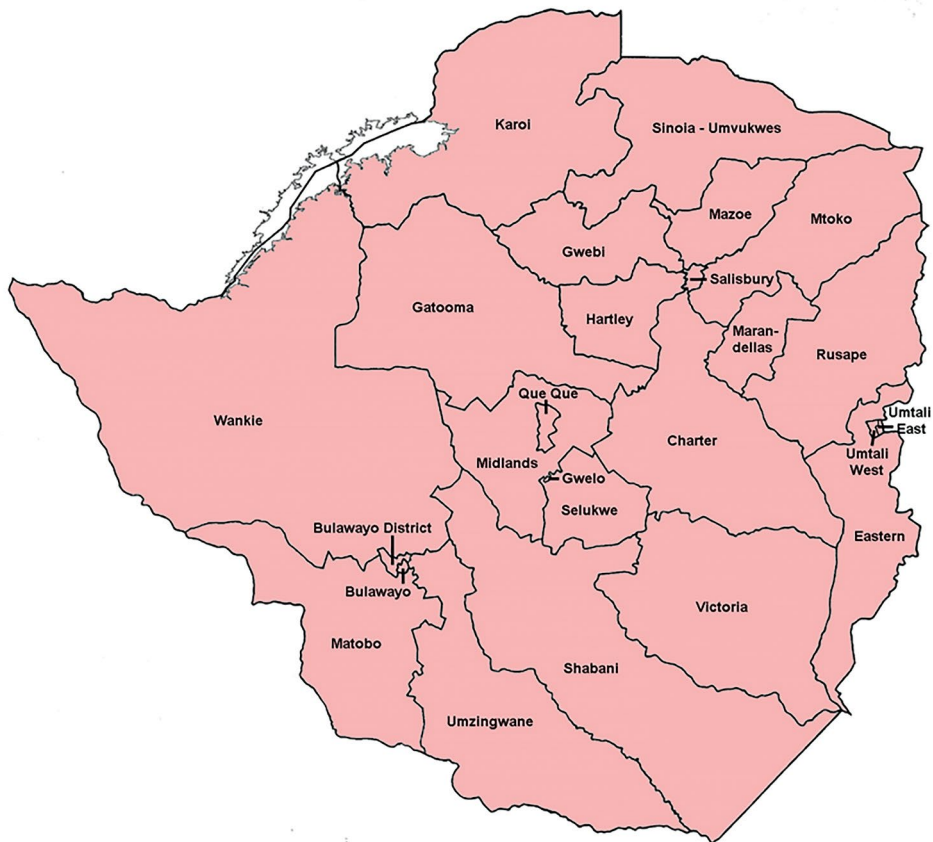


Figure 1: Southern Rhodesia districts, 1970.

Source: commons.wikimedia.org/wiki/Category:Maps_of_Rhodesia#/media/File:Rhodesia1970a.png, accessed 3 October 2019.

49 Robert Van den Bosch, *The Pesticide Conspiracy* (Berkeley, CA: University of California Press, 1978), 21.

50 In the United States during the post-war period, public health and agricultural experts engaged in development projects to eradicate famine and disease through deployment of modern pest control technologies using DDT and other chlorinated hydrocarbons. Carson documents several such government-sponsored spray programs. In 1954, the US Department of Agriculture started a spraying program to eliminate the Japanese beetle in Illinois and applied dieldrin to 1,400 acres by air; in 1955, another 2,600 acres were treated similarly. In 1959, 27,000 acres in Michigan were dusted with pellets of aldrin.

51 Kinkela, *DDT and the American Century*, 9.

In Southern Rhodesia, DDT was registered for agricultural use in 1946, and by 1947 it was being used following an army worm outbreak in maize in early January (first in Gatooma before spreading to Victoria, Salisbury and Nyamandlovu districts (see Figure 1))⁵². DDT was found to be effective and was considerably cheaper than using gangs of African labour to physically pick up the worms; consequently, it formed the basis of tentative government recommendations for control in maize.⁵³ In 1947 the Pest Control Research Committee was set up by the Rhodesia Tobacco Association (RTA) to speed up research on tobacco pest control.⁵⁴ This followed the admission by the association in its report that year that work on the control of pests and diseases troublesome in Rhodesia had not progressed as far as could be wished. This pest and diseases control infrastructure became more important following the post-war tobacco boom that witnessed production increasing on the back of favourable market conditions and the entry of many new growers.⁵⁵ The government, through a subsidised scheme, agreed to cooperate with the RTA and a private company Pest Control Africa Ltd to investigate tobacco diseases. Spraying was to be carried out on various tobacco farms over four years starting from June 1947.⁵⁶

Field-spraying operations were conducted on an extensive scale on the tobacco farms, beginning in 1948.⁵⁷ In 1948 DDT was listed by Pest Control Africa as one of the new insecticides to be tested on tobacco, amongst other chlorinated hydrocarbons that included benzene hexachloride, chlorinated camphenes and Thiophos 3342.⁵⁸ By 1955, DDT and the organochlorine insecticide aldrin were being recommended by the Tobacco Research Board (TRB) and were also being widely used by many growers for the control of cutworm (*Agrotis ipsilon*) in both the nursery and field operations.⁵⁹ Not only was DDT being used in the field and nursery, it was also used in the cleaning of tobacco shades and applied as whitewash to leave a residual coating on the walls to control the tobacco beetle (*Lasioderma serricorne*) in cured leaf.⁶⁰ Nematocides and soil fumigants such as

52 Report of the Division of Entomology, December 1947.

53 *ibid.*

54 J. C. F. Hopkins, 'Field Spraying and the Control of Leaf Diseases on Tobacco: Review Report—1948'. S25101/1, TRB Tobacco Pest Spraying Scheme. National Archives of Zimbabwe (NAZ).

55 See Frank Clements and Edward Harbern, *Leaf of Gold: The Story of Rhodesian Tobacco* (London: Methuen, 1962), 150–1.

56 'TRB Tobacco pest spraying scheme, 1948.' S25101/1, NAZ.

57 *ibid.*

58 Pest Control and Plants, 1947–52, E. Parry Jones (Managing Director Pest Control Africa), 'Research on Tobacco Pests and Diseases'. S2708/1, NAZ.

59 Tobacco Research Board, 'Recommendations for Flue-Cured Tobacco' (1955), 8.

60 *ibid.*, 1961, 12.

ethylene dibromide (EDB) and methyl bromide⁶¹ for the control of eelworm and root knot nematodes were also being recommended because of the dwindling supply of so-called virgin lands.⁶² Soil fumigation experiments were started at the tobacco research station in 1949.⁶³ By 1957, the TRB reported that soil fumigants were extensively used throughout the federation⁶⁴ both in seedbeds and in lands for the control of eelworms.⁶⁵ A 1961–62 survey revealed that out of the total of 224,000 acres of tobacco, the amount of land fumigated for nematode control was approximately 104,832 acres (46.8 per cent).⁶⁶ Carson identifies nematocides and other forms of soil treatment as being harmful as they eliminate the biological life in the soil.⁶⁷ She further posits that biological control of eelworm and nematodes through planting resistant crops such as marigolds was more helpful than chemical sprays.⁶⁸ In Southern Rhodesia during this time, although grass-ley rotations were used in tobacco to control eelworms, the use of nematocides on rotated lands was highly recommended by the TRB.⁶⁹

By the 1960s, the proliferation of pests and diseases on the tobacco farms was becoming a growing concern to the state, especially since some of the insect pests were evidently becoming resistant to chlorinated hydrocarbons.⁷⁰ Organophosphate pesticides became more popular with farmers around the mid to late 1950s.⁷¹ The pest control infrastructure that was developing in tobacco farms and the pest complex reflected the general trend in much of Africa from the late 1940s as colonial governments sought to expand the area of land available for occupation

61 EDB was first used in 1926 as an insecticide in the United States, although it was first commercially registered in 1946. In 1973, several studies showed that it was carcinogenic and caused birth defects, leading to its ban as a soil fumigant in the United States in 1983. Methyl bromide is an organic bromide compound used as an insecticide. It first came into use in 1932 and was registered for use in the United States in 1961. It contains ozone layer-depleting chemicals and is highly toxic. For this reason, it was banned for use in tobacco fumigation and has been phased out in many countries, including Zimbabwe, by the 2005 Montreal Protocol.

62 Nematodes had been a recurring and perennial problem on tobacco farms since the expansion of tobacco production in the 1920s. Before the advent of nematocides in the 1940s, the only form of control was cultivating virgin lands, as tobacco grown on second-year lands would be badly affected.

63 H. Weinmann, *Agricultural Research and Development in Southern Rhodesia, 1924–1950* (Salisbury: University of Rhodesia, 1975), 78.

64 Between 1953 and 1963, the three Central and Southern African British colonies of Southern Rhodesia, Nyasaland and Northern Rhodesia amalgamated into the Federation of Rhodesia and Nyasaland. The federation amalgamated most services under one authority and the TRB became a federal institution responsible for tobacco research in all the three territories.

65 'Chemical Control of Eelworm', *Rhodesia Tobacco Journal* (July 1957).

66 A. Daulton, 'Survey of Land Use and Plant Parasitic Nematodes Control', *Rhodesian Agricultural Journal* 59 (July–August 1962).

67 Carson, *Silent Spring*, 65.

68 *ibid.*

69 R. C. Salmon (Officer in Charge Kutsaga Research Station), 'Some Thoughts on Second Year Tobacco'. F257/110/GEN Tobacco General: Bulletins and articles 1963. NAZ.

70 'Pests Cost 20 Million Pounds Every Year', *Rhodesian Herald*, 18 February 1961.

71 Chlorinated hydrocarbon insecticides are persistent and build up in the food chain and fatty acids of mammals; they are, however, less toxic to humans and animals. Organophosphate pesticides can easily be broken down and have no residual effect on the environment, but they are more lethal to humans and animals.

through pest eradication programs.⁷² In Rwanda-Burundi in the Rukwa Valley from August to November 1947 an experimental aerial 'hopper' campaign was launched at an estimated cost of £57,000.⁷³ A ground dusting campaign was conducted in September and October using Messinger machines, DNOC dust and gammaxene.⁷⁴ In southern Africa the spraying campaigns became imperative as the numbers of new (white) settlers on the land increased following the post-Second World War settlement schemes and at a time when tsetse fly infestations were hampering expansion of settler agriculture and large-scale ranching.⁷⁵ In Southern Rhodesia, ground spraying operations with dieldrin and DDT were conducted, beginning in 1950 on an extensive scale in both African and European areas to control tsetse flies, with huge numbers of native labourers mobilised to work in unsafe conditions while spraying large areas.⁷⁶ In South Africa, from the 1950s large quantities of a chlorinated hydrocarbon pesticide dieldrin mixed with fuel were sprayed in areas around Kruger National Park to control rinderpest.⁷⁷

These spraying programs were touted as depicting mastery over nature and constituting the colonial vision of modernising Africa expressed in such justificatory ecological catchphrases as 'taming the wilderness', 'conquering the fly' and 'pushing back disease'.⁷⁸ These ecological interventions were steeped in the notion of racial and cultural superiority under which European settlers perceived themselves to be the benchmark of progress and civilisation in Africa. White power and privilege formed the basis of this ideology, which further casts blacks and other non-white racial groups as ignorant of and destructive to the environment, as well as being uncivilised.⁷⁹

Environmental historians have, however, disparaged this racial bigotry as ahistorical in understanding the complex dynamics of colonial ecologies. Alfred Crosby in particular framed the colonial pest and pathogen epidemics that devastated much

72 The Anti-Locust Research Centre in London observed in 1948 that Africa's development was threatened by locust plagues as the hoppers would develop into dangerous pests as soon as suitable soils were found and abundant food created by the clearing of forest areas and mechanised agriculture.

73 *Record of Conference of the International Red Locust Control Service held in Salisbury on the 25th, 26th and 27th of May 1948* (Lusaka: Government Printer, 1948), 11.

74 *ibid.*

75 Scoones, 'The Politics of Trypanosomiasis Control in Africa', 12.

76 *ibid.*, 13. For a comprehensive history of tsetse fly control in Southern Rhodesia, see Rory Pilosof, 'A Brief History of Tsetse Control Methods in Zimbabwe and Possible Effects of Climate Change on Their Distribution', *International Journal of African Development* 4, no. 1 (2016): 88–101.

77 *ibid.*

78 John Mackenzie, 'Empire and the Ecological Apocalypse; The Historiography of the Imperial Environment', in *Ecology and Empire: Environmental History of Settler Societies*, ed. Tom Griffith and Libby Robin (Edinburgh: Keele University Press, 1977), 215–28. Also see J. Giblin, 'Trypanosomiasis Control in African History—An Evaded Issue'; Hoppe, *Lords of the Fly*. These works provide a framework for understanding how colonial pest control programs were justified in the language of modernisation such as 'taming the wilderness', 'conquering the fly' and 'pushing back disease'.

79 David Anderson and Richard Grove, *Conservation in Africa: People, Politics and Practice* (Cambridge: Cambridge University Press, 1987), 4.

of the colonial Americas as ‘exported’ ecological disasters.⁸⁰ Orthodox Africanist scholarship has also challenged the narratives informing these colonial scientific interventions in African ecologies as being limited, disruptive and based on the logic of resource exploitation for settler gain.⁸¹ Helge Kjekshus blames colonialism for the spread of diseases and epidemics such as tsetse fly and trypanosomiasis in Tanzania.⁸² John McCracken, in his study of Malawi, was also highly critical of the role of experts in understanding the pest and ecological dynamics in cotton production.⁸³ Although focusing on the period before the end of the Second World War and the advent of large-scale chemical pest control programs in Africa, these works’ challenge to science and its utility in the reshaping of vernacular landscapes and ecologies share affinities with the environmentalism in *Silent Spring*, which questioned society’s unflinching faith in the scientific control of nature.

Despite the prevalent scepticism of the utility of colonial knowledge systems in African ecologies, revisionist scholars in the 1990s came to view the colonial scientific and technological developments as being core to imperial development and playing a critical role towards the facilitation of effective exploitation of natural resources for agriculture and industry through environmental transformation.⁸⁴ In the case of Southern Rhodesian tobacco, the scientific knowledge of pest control, however, failed because the problem was linked to the increases in production, which followed the post-war boom as tobacco overtook gold to become the principal export earner in 1947.⁸⁵ With increased acreages to meet the huge demands of the export market,⁸⁶ the pest pressure also increased as a result of the changing production patterns, which altered the natural ecosystem and created a pest explosion as a result of human ecological engineering. This evokes Carson’s prescient musing in *Silent Spring*: ‘we are told that the enormous and expanding use of pesticides is necessary to maintain farm production. Yet is our real problem not one of over production?’⁸⁷

80 Crosby, ‘Ecological Imperialism’, 112.

81 *ibid.*

82 Helge Kjekshus, *Ecology Control and Economic Development in East African History: The Case of Tanganyika, 1850–1950* (London: Heinemann, 1987).

83 John McCracken, ‘Experts and Expertise in Colonial Malawi’, *African Affairs* 81, no. 322 (1982): 101–16, doi.org/10.1093/oxfordjournals.afraf.a097384.

84 See Hellen Tilley, ‘African Environments and African Social Sciences: The African Research Survey, Ecological Paradigms and British Colonial Development’, in *Social History and African Environments*, ed. William Beinart and Joann McGregor (Oxford: James Currey, 2003); William Beinart, Karen Brown and Daniel Gilfoyle, ‘Experts and Expertise in Colonial Africa Reconsidered: Science and the Interpenetration of Knowledge’, *African Affairs* 108, no. 432 (July 2009): 413–33, doi.org/10.1093/afraf/adp037.

85 David M. Rowe, *Manipulating the Market: Understanding Economic Sanctions, Institutional Change and the Political Unity of Southern Rhodesia* (Ann Arbor, MI: University of Michigan Press, 2001), 69, doi.org/10.3998/mpub.15943.

86 Southern Rhodesia’s tobacco exports rose from an average of 14,000 metric tons during 1940–45 to 121,000 metric tons in 1965, accounting for approximately one third of the free world’s tobacco exports.

87 Carson, *Silent Spring*, 8.

There were several outbreaks of various tobacco diseases in most parts of the country.⁸⁸ An outbreak of tobacco rosette occurred in the Lomagundi area in December 1953, leading to total losses of seedbeds and November plantings.⁸⁹ Despite a determined effort by growers to spray with parathion, the disease was not checked, and by the end of February 1954 the disease was reported from all over the colony.⁹⁰ The failure of the spraying to contain the disease did little to dampen the firm faith in and conviction of the utility of chemical control. The TRB insect control program for seedbed and field control under a government notice in 1958 recommended aldrin, dieldrin, parathion, DDT and malathion for routine pest control.⁹¹

In 1961, the President of the Pesticides Association of Rhodesia and Nyasaland, W. L. Cosker, lamented that the damage caused by pests to tobacco in Southern Rhodesia amounted to £10 million annually.⁹² In 1960, there was a serious outbreak of 'Bushy top disease',⁹³ described as 'the biggest menace to the tobacco growing industry'.⁹⁴ The ravages of the bushy top virus were so severe that there was an urgent call by tobacco farmers exhorting the government to introduce legislation to force all growers to comply with TRB recommendations for regular sprayings.⁹⁵ Because of this huge surge in bushy top, systemic pesticides⁹⁶ were now being recommended by the TRB for use on tobacco. In 1960, the first systemic insecticide used in Southern Rhodesia, Rogor 40,⁹⁷ was unveiled.⁹⁸ The TRB noted that the systemic insecticide would reduce the incidence of virus diseases in certain plants since it was more persistent than malathion and parathion.⁹⁹ In 1962, a second systemic pesticide (Menazone) for the control of bushy top and tobacco rosette was recommended by the TRB.¹⁰⁰ For the first time, the TRB recommended field spraying of Turkish tobacco as a routine measure to give protection against white mould, rosette and bushy top diseases.¹⁰¹

88 Various outbreaks of tobacco anthracnose were reported in the *Rhodesian Herald* between 1953 and 1958 as having been prevalent in Marandellas, Karoi, Lomagundi and Banket Districts.

89 Tobacco extension officer to Senior tobacco extension officer, 21 April 1954. F149/TOB/360, Tobacco Diseases and Pests, 1956–58. NAZ.

90 *ibid.*

91 Federal Government Notice 1958: Plant Pest and Disease Regulations. F149/TOB/360, Tobacco Diseases and Pests, 1956–58. NAZ.

92 'Pests Cost 20 Million Pounds Every Year', *Rhodesian Herald*, 18 February 1961.

93 'Southern Rhodesian Growers Worried About the Spread of Tobacco Plant Diseases', *Rhodesian Herald*, 7 March 1961.

94 *ibid.*

95 'Urgent Call for Law to Force Growers to Curb Bushy Top', *Rhodesian Herald*, 29 March 1961.

96 Systemic pesticides work by being absorbed by the plant tissues and making the whole plant poisonous.

97 Rogor, also known as dimethoate in the United States and fosfamide in Russia, was introduced and patented in the 1950s by a US chemical company, American Cynamid.

98 'How to Use Systematics Recommended for Tobacco', *Rhodesian Herald*, 22 September 1960.

99 *ibid.*

100 'TRB Releases New Systemic for Tobacco Virus Diseases', *Rhodesian Herald*, 15 November 1962.

101 *ibid.*

By November 1962, therefore, tobacco farmers in Southern Rhodesia were armed with the deadly triad of chlorinated hydrocarbons, organophosphates and systemic poisons. The pesticide revolution had been completed, yet the war on pests continued and, despite the accumulating deadliness and toxicity of the chemicals, which kept on escalating at each stage of the chemical evolution, the pest problem remained. Despite a surge in the use of hitherto unknown chemicals whose toxicity to human and natural life kept on escalating, no regulations were put in place to control pesticide usage in Southern Rhodesia, just as was the case elsewhere in the world at this stage. There were several risks of contamination and poisoning, particularly on the tobacco farms where all the work was done by African labourers who were politically largely powerless.¹⁰² Rob Nixon, in discussing environmental 'slow violence', has shown how disempowered social groups are usually the casualties of environmental violence.¹⁰³ He points out that the poor suffer the challenge of invisibility and amnesia, and usually remain on the margins of official memory.¹⁰⁴ This 'slow violence' transcends defined boundaries in time and space and happens over extended geographical and technological displacements, which hides its severity and, in retrospect, the human and environmental costs.¹⁰⁵ Ian Scoones has demonstrated how power dynamics during the colonial period indelibly etched themselves on pest control programs that followed a top-down technocratic approach.¹⁰⁶ This required mobilising a subservient African labour force in highly dangerous ground-spraying campaigns. Africans were the expendable race and, as one observer put it:

under colonialism, you could tell people what to do without masks, without gloves, in the sheer heat of the dry season. Who cared because you could get the people? There were armies of people with knapsacks on their backs. There were used as slaves.¹⁰⁷

This generic reference to the conditions under which pest control programs were conducted in Africa and the plight of the disempowered African labourers is very much akin to the situation in Southern Rhodesia where chemical field spraying was done by black workers. Although in some cases pest control was conducted using aerial sprays, these were expensive, and ground spraying operations using knapsack sprayers and African labour were conducted on a more extensive scale on Southern Rhodesian farms. It is impossible to ascertain the magnitude of the slow chemical violence on the tobacco farms in Southern Rhodesia in the absence of any available

102 The concept of power and class in environmentalism has received a great deal of scholarly attention since the entry of 'environmental justice' as a critical concept in ecocriticism and environmental history in the 1990s. See Robert Bullard, *Dumping in Dixie: Race, Class, and Environmental Quality* (Boulder, CO: Westview, 1990); Andrew Hurley, *Environmental Inequalities: Class, Race and Industrial Pollution in Gary, Indiana, 1945–1980* (Chapel Hill, NC: University of North Carolina Press, 1995).

103 Nixon, *Slow Violence and the Environmentalism of the Poor*, 2.

104 *ibid.*, 6.

105 *ibid.*, 7.

106 Scoones, 'The Politics of Trypanosomiasis Control in Africa', 5.

107 *ibid.*

evidence, but it may be that there were generations of silent casualties. After all, colonial authorities were notorious for their lack of concern for the health and safety of their black employees.¹⁰⁸

Locating Southern Rhodesia in the global pesticide regime and the environmental backlash, 1965–70

From the 1960s, based on Carson's revolutionary ideas in *Silent Spring*, a nascent global movement had begun that interrogated the impact of pesticides on the environment. This movement, which started in the United States, focused primarily on the residual effects of chemical pesticides on the environment and the accompanying hazards to humans and wildlife. In 1962, Carson's book opened a floodgate. This trickle became a public stream that filtered into official discourses about the long-term effects of pesticide use in agricultural production. Carson's work reached policy makers, government agencies, environmental scientists and chemical manufacturers in the United States and elsewhere in the global North.¹⁰⁹ It evoked a fierce and wide-ranging debate in the United States: Carson faced visceral opposition from the chemical industry who accused her of being an agricultural propagandist and, in a predictably sexist attack, a catastrophising 'spinster with an affinity for cats'.¹¹⁰ Her work, however, culminated in pesticide use becoming a subject of agricultural policy intervention globally by the mid-1960s. The report of the President's Science Advisory Committee (PSAC) in the United States (1963) became the first official government critical evaluation of the hazards of pesticides.¹¹¹ Amongst other things it called for the need to monitor levels of pesticide residues in the environment and for the federal government to restrict wide-scale use of persistent insecticides.¹¹² The report went further and poignantly stated that 'until the publication of *Silent Spring* by Rachel Carson, people were generally unaware

108 *ibid.*, 14.

109 There is an extensive literature that acknowledges the contributions of Carson to the environmental movement. See Mark Hamilton Lytle, *The Gentle Subversive: Rachel Carson, the Silent Spring and the Rise of the Environmental Movement* (New York: Oxford University Press, 2007); Linda J. Lear, 'Rachel Carson's Silent Spring', *Environmental History Review* 17, no. 2 (1993): 23–48, doi.org/10.2307/3984849; Ralph H. Lutt, 'Chemical Fallout: Rachel Carson's Silent Spring, Radioactive Fallout and the Environmental Movement', *Environmental History Review* 9, no. 3 (1985): 210–25, doi.org/10.2307/3984231; Lawrence Culver, 'Reading *Silent Spring* as a Challenge for Contemporary Environmentalism', *RCC Perspectives* 7 (2012): 31–4.

110 Eliza Griswold, 'How "Silent Spring" Ignited the Environmental Movement', *New York Times*, 21 September 2012, www.nytimes.com/2012/09/23/magazine/how-silent-spring-ignited-the-environmental-movement.html, accessed 18 September 2018.

111 For a full understanding of the import of the PSAC report see D. S. Greenberg, 'Pesticides: Whitehouse Advisory Body Issues Report Recommending Steps to Reduce Hazards to Public', *Science News Series* 40, no. 3569 (1963): 878–9, doi.org/10.1126/science.140.3569.878.

112 Linda J. Lear, 'Bombshell in Beltsville: The USDA and the Challenge of "Silent Spring"', *Agricultural History* 66, no. 2 (Spring 1992): 151–70.

of the toxicity of pesticides'.¹¹³ The subsequent PSAC report (1965) concluded that environmental pollution by pesticides could be reduced significantly without losing efficiency.¹¹⁴

In North America, the environmental movement in the 1960s stemmed from the instigation of activists like Carson and drew much of its galvanising force from the power of the mass media and social movements that spoke to diverse national constituencies. But in the global South such prodding emerged largely from the state under pressure from globalising influences from the North, and in most cases this environmentalism was usually a mere smokescreen to comply symbolically with global norms largely for the purposes of national economic interests rather than genuine environmentalism. This must be understood in the context of the dichotomy between the environmentalism of affluent societies and the environmentalism of poor and less developed polities. North American environmentalism was deeply rooted within the liberal agenda of the mid-1950s championed by Arthur M. Schlesinger and John Kenneth Galbraith.¹¹⁵ The liberal agenda espoused during the period of post-war American affluence visualised the environment as a public good that was being defiled by overconsumption, and identified the need to expand the role of government in addressing its degradation.¹¹⁶ The preservation of public spaces for aesthetic and amenity purposes thus framed the discourse of American environmentalism. Shawn Miller points out that for rich nations environmentalism is driven by the alienation of people from nature because of modernisation, while for poor countries it is motivated by the knowledge that livelihoods depend on nature for survival.¹¹⁷ In other words: 'the first is driven by dreamy myth, the second by stark reality'.¹¹⁸ While this binary generally holds true in explaining the contrast in environmentalisms between the North and the South, it is limited in its ability to unpack the various racialised nuances within the global South where racial identity is a big factor and predetermines the different sites of location for blacks and whites within the environmental movement. Thus, in much of colonial Africa, the agenda of the mainstream environmental movement (just as in the global North) appealed to the affluent white minority interests broadly centred on the preservation of nature and wildlife sanctuaries, while alienating black Africans who were often accused of degrading the environment.¹¹⁹ The influence of environmentalism from the global North thus percolated through racial lines, affecting and influencing the black

113 Lear, 'Rachel Carson's Silent Spring'.

114 Graham, *Since Silent Spring*, 179.

115 See Arthur Schlesinger, 'The Future of Liberalism: The Challenge of Abundance', *Reporter*, 3 May 1956, 8–11, and John Kenneth Galbraith, *The Affluent Society* (Boston: Houghton Mifflin, 1958).

116 Adam Rome, 'Give Earth a Chance: The Environmental Movement and the Sixties', *Journal of American History* 90, no. 2 (September 2003): 525–54, doi.org/10.2307/3659443.

117 Miller, *An Environmental History of Latin America*, 215.

118 *ibid.*

119 Khan, 'The Roots of Environmental Racism', 16.

Africans and Europeans in different ways, but largely in a configuration in which black Africans were the victims of the top-down technocratic interventions that were meant to protect the environmental and economic interests of settler society.

The board of the Southern Rhodesian Tobacco Advisory Committee (a body representing manufacturers and merchants in the United Kingdom) was the first in the country to react to the concerns stirred by Carson's work and lobbied the government of Southern Rhodesia on the need for pesticide control regulation of tobacco.¹²⁰ As we will show, the motive behind this was largely to protect the reputation of the lucrative tobacco export leaf for being pesticide contamination-free more than any genuine environmentalism. The state was compelled to act accordingly and promptly launched a Pesticide Approval Scheme to guide growers in selecting suitable pesticides. The scheme emphasised the need for a handbook to inform farmers on how to apply pesticides safely and effectively.¹²¹ The TRB noted that the Pesticide Approval Scheme was becoming more necessary as growers were getting confused by the 'increasing number and complexity of pesticides', and consumers had been alerted to the 'presence of pesticides in some agricultural produce by the recent publicity on the misuse of pesticides'.¹²² This publicity was a result of Carson's work and the seismic waves it had stimulated in influencing governments of various states all over the world over the need for pesticide regulations, and it reflects the far-reaching influence *Silent Spring* had in propagating new narratives on pesticide use—even in Africa. These narratives were, however, scripted to meet local contexts.

In Southern Rhodesia, the TRB insisted that it had to be satisfied that the materials were safe and did not impart undesirable residues to the leaf, increasing health hazards to the consumers and endangering the export market.¹²³ Furthermore, for the first time all chemicals used in tobacco were supposed to carry triangle emblems signifying the level of their toxicity, colour-coded from green to purple.¹²⁴ Instructions for use and safe disposal, and procedures for treatment in the event of accidental poisoning were also supposed to be required in the labelling. The interests of these initiatives were of course disconnected from the concern about the environment, and more intensely attached to securing a global market for Rhodesian tobacco, hence this was more an imposed environmentalism emanating from concerns of British tobacco buyers and merchants. The TRB argued that 'the scheme protects the industry and assures potential buyers of Rhodesian leaf that the use of pesticides on Rhodesian leaf is controlled and responsible'.¹²⁵ These provisions were gazetted under the Fertilisers, Farm Seeds and Remedies Regulations of 1965. During the

120 'How Pesticides Gain the Stamp of Approval', *Rhodesian Tobacco Journal* (May 1965).

121 *ibid.*

122 *ibid.*

123 *ibid.*

124 *ibid.*

125 *ibid.*

same year, the use of the herbicide maleic hydrazide on tobacco was banned in Southern Rhodesia following a report that had been published by the Department of Agriculture in the United States in May 1960 revealing that it changed the chemical composition and physical properties of the leaf in a way that would endanger cigarette smokers.¹²⁶

Just as in the United States, the 1965 legislation marked only a superficial turning point in perceptions of the use of pesticides on tobacco farms as sporadic official voices began a conversation around the responsible use of these products. C. H. Cronin, the technical manager of a Salisbury pest control firm, issued a warning on the dangers to operators on tobacco farms of being exposed to methyl bromide when fumigating seedbeds.¹²⁷ He pointed out that methyl bromide was an extremely toxic substance. He warned:

The effects of a single massive exposure are well known, but it has also been discovered that exposure to low concentrations over a long period of time may have severe prolonged effects on the human body. A number of such cases has been reported in the British medical literature ... these cases underline the view that Methyl Bromide is highly toxic and that recommended safety precautions must be observed. It is disastrous for a labourer using Methyl Bromide whose clothing has become contaminated to either sleep in the garments in a poorly ventilated room or to take them off and leave them beside the bed.¹²⁸

The TRB also advised growers that the modern chemicals used for the control of insects were highly toxic, and special precautions had to be taken by farmers and their labour force using them.¹²⁹ It advised against the drinking of alcoholic beverages before or during work as alcohol promotes the rapid absorption of organophosphates.¹³⁰ These conversations between officials and tobacco farmers were, however, largely limited to technical concerns, with little attempt to ensure limiting the exposure of the African workers who did all of the work on the tobacco farms, by making it compulsory through legislation for farmers to equip labourers with the requisite protective clothing, creating exposure-free work environments and providing information to labourers on safe use. In the absence of consumer pressure from Britain targeting pesticide exposure of workers in particular, farmers showed less regard and concern for that aspect.

Nevertheless, by the beginning of the 1970s, a range of diverse attitudes—from both state and farmers—to the need for responsible chemical use in tobacco farms in Southern Rhodesia were congealing into something resembling a coherent policy. This was reflected in the legislative manoeuvres and initiatives by the TRB. Just as

126 Tobacco Soil and Leaf Analysis Reports. F256/TOB/260. NAZ.

127 'Tobacco Farmers Warned of Poisoning Danger', *Rhodesian Herald*, 22 April 1965.

128 *ibid.*

129 Tobacco Research Board, 'Bulletin on Burley Tobacco Culture in Southern Rhodesia' (1970), 3.

130 *ibid.*

in the United States, these initiatives underwent severe public and state scrutiny. This was particularly true in key turning points between 1968 and 1970 as global perceptions on chemical use gained remarkable consensus on the need for not only controlled use of some of the products, but also their total ban in several spheres of agricultural production. In 1968, for example, the US Government under pressure from the environmental lobby issued notices cancelling four uses for DDT: on shade trees, tobacco plants, around homes and on marshes except for control of disease carriers, before banning it eventually in 1972.¹³¹ In West Germany, for example, the use of chlorinated hydrocarbon pesticides on foodstuffs had been banned, and there were considerations to extend the ban to its use on tobacco in 1973.¹³² Meanwhile a German tobacco-buying company had announced in 1970 that it would no longer purchase tobacco that had been directly or indirectly treated with aldrin, dieldrin or heptachlor.¹³³ As these developments were happening elsewhere, they took centre stage in Southern Rhodesia where an impassioned debate between various government agencies took place. This debate pitted the state Health Department against the Ministry of Agriculture and reflected the unique and stark realities that had to be confronted in domesticating the American template of environmentalism in Southern Rhodesia.

The debate was the result of a report by the Acting Medical Officer of Salisbury in 1969, which had pointed out that toxic agricultural residues existed in food and called for the need for some form of legislation that could ban DDT and other persistent pesticides and replace them with less persistent Sevin and malathion.¹³⁴ D. H. Saunders, the Director of Research and Specialist Services, opposed the ban of synthetic chlorinated hydrocarbons as 'the total replacement of DDT, Lindane, Aldrin and Dieldrin by Marathion and Sevin would result in increased expenditure by the farmer'.¹³⁵ He argued that Sevin and marathion were not replacements for these chemicals and such a substitution would cause 'a most catastrophic breakdown in pest control with consequences on the economy, not only to the farmer, but the nation as a whole'.¹³⁶ As an alternative, he proposed a strict control on usage of these pesticides by a registration scheme which criminalised their sale and unlicensed distribution.¹³⁷

131 Kinkela, *DDT and the American Century*, 145.

132 Minutes of the Meeting on Pesticides on Tobacco held 4 September 1970, 42-12-5F, Box number 126962, Pesticide control legislation, NAZ.

133 *ibid.*

134 D. H. Saunders cites the Report in his correspondence with the Secretary of Agriculture on 3 June 1969. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

135 D. H. Saunders to the Secretary of Agriculture, 3 June 1969. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

136 *ibid.*

137 *ibid.*

Dr Timothy Stamps of the Salisbury health department noted on 14 April 1969 that pesticides such as dieldrin remain in the soil for many years after use and contaminate underground water supplies.¹³⁸ He added that research was being directed into the effects of residual chemicals on fish and plants in the dams, and the ecology of the country could be affected if nothing was done.¹³⁹ He also observed that vegetable growers had crops that were found with unacceptably high traces of dieldrin.¹⁴⁰ In response, the Director of Research and Specialist Services countered with: 'we do not propose to ban DDT, or other more persistent chlorinated hydrocarbons such as Dieldrin, but we shall seek to limit their use'.¹⁴¹

The Research Services department continued with their denial, pointing out that in Southern Rhodesia (where pest pressure was more intense than in the United States and other temperate countries) it was very difficult to see how a complete ban on the persistent hydrocarbons would even be possible.¹⁴² In his correspondence with the Secretary of Agriculture, Saunders staunchly stated:

Aldrin, Dieldrin and DDT all have a part to play in controlling the pest complex which prevails in this country, and although research work is proceeding in an endeavour to replace these chemicals with less persistent and toxic ones, it is doubtful if a complete ban will be realised in the near future. Nevertheless, the ministry of agriculture has under consideration new regulations for more effective control of the sale, possession of DDT and other substances will be subject to control which will prove adequate.¹⁴³

The Minister of Agriculture shared similar views to the Department of Research and Specialist Services on the need for more regulation and control, as opposed to a complete ban on these chemicals. During a debate in the Legislative Assembly on 29 August 1969, the minister observed that the most convenient policy initiative would be to amend the Farm Seeds, Pests and Remedies Act in conjunction with and simultaneous to the introduction of a Hazardous Substance Act, arguing: 'I believe that between these two pieces of legislation when they become law, the manufacture, distribution, packaging, sale, possession of DDT and other substances will be subject to control which will prove adequate'.¹⁴⁴

138 Minutes of a Meeting to Consider Action on Control and Distribution of Pesticides Held on 14 April 1969 at 15 Cheshire Road Salisbury, Box number 126962, Pesticide control legislation, NAZ.

139 *ibid.*

140 *ibid.*

141 D. H. Saunders to Secretary of Agriculture, 20 August 1969. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

142 *ibid.*

143 D. H. Saunders to Secretary Agriculture, 2 September 1969. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

144 *Votes and Proceedings of the Legislative Assembly* (Salisbury: Government Printer, 1969).

The denialism of the Ministry of Agriculture on the need to ban the use of highly persistent pesticides such as DDT persisted even in the face of growing and terrifying evidence. On 17 December 1969, the Doma Intensive Conservation Area (ICA)¹⁴⁵ wrote a letter to the secretary of the Natural Resources Board, Mashonaland North, reporting that because of DDT spraying in the catchment area of a dam, subsequent rainfall had washed much of the spray down into the dam.¹⁴⁶ In this dam a white farmer had stocked black bass, which died after the subsequent spraying and rains. The bream in the same dam were also dead. The letter went further:

The question arises on whether the water will be safe for humans and livestock and also what the effect will be if humans eat any of the dead fish or meat which has obviously been killed ... But it raises the question previously raised in other countries i.e. whether the use of DDT for field scale pest control is not altogether too risky, or whether it should be banned or severely curtailed.¹⁴⁷

The Natural Resources Board (NRB) noted that the situation was potentially serious and had in fact posed serious problems.¹⁴⁸ Unsurprisingly, however, Saunders denied that the poisoning in the dam was a result of DDT spraying. In his letter to the Secretary of Agriculture, he insisted that conventional application of DDT could never cause the death of large numbers of fish in a distant dam.¹⁴⁹ To him, current information was that once DDT is washed into the soil, it was very quickly absorbed by the soil particles and was not leached out, even in heavy rain. Even if washed into the dams, he argued, the DDT will only be slowly released from the soil particles and it was highly unlikely that it would produce the observed massive kill of fish.¹⁵⁰ He concluded rather ambiguously:

It is more likely that pollution of this type is due to the misuse of DDT for example: drift from the ground (mist blowers and aerial spraying), washing of spray equipment or tipping of excess DDT on the tributaries of the dam for the purposes of catching fish. Properly used on the crops there should be no health hazard and I would emphasize that most poisonings have arisen from misuse.¹⁵¹

145 Intensive Conservation Areas had been set up in white settler farming communities in 1948 for the conservation of natural resources. The ICAs were geographically demarcated units comprising several European farms that would draw resources together with state assistance towards such activities in the area as building contour ridges, afforestation, building dams and monitoring environmental degradation.

146 Doma ICA District Secretary (R. N. Gallico) to Secretary Natural Resources Board, 17 December 1969. 42-12-5F, Box Number 126962, Pesticides Control Legislation. NAZ.

147 *ibid.*

148 Natural Resources Board Secretary (D. J. S. Wilson) to Director of Water Development, cc Secretary of Agriculture and Secretary of Health, 23 December 1969. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

149 D. H. Saunders to Secretary of Agriculture, 6 January 1970. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

150 *ibid.*

151 *ibid.*

Despite these denials, however, a vast amount of evidence was building up in different quarters. The Rhodesian Veterinary Association was raising its voice on the accumulation of pesticide residues in animal tissues used for human consumption,¹⁵² the National Council of Women of Southern Rhodesia was also lobbying extensively about pesticide contamination of vegetables and instituted its own investigation.¹⁵³ These pressures, however, failed to elicit a robust state pesticide policy and only resulted in the token withdrawal of DDT for domestic and garden uses in 1973,¹⁵⁴ while it continued to play a bigger part in pest control in most crops (particularly maize, where it was used for the control of stalk borers). During the 1970s, Southern Rhodesia is estimated to have used 1,000 tonnes of DDT per year, with 300 tonnes used on maize.¹⁵⁵ The story was, however, quite different in tobacco where a modicum of control was established, largely because the sector relied on the export market which was insisting on the need to regulate pesticide contamination and could little afford to ignore the economic ramifications of non-compliance to the global pest control template.¹⁵⁶

‘A smokescreen of environmentalism’? The tobacco pesticide control scheme, 1970–80

Unlike other practitioners of agriculture in Southern Rhodesia, tobacco farmers relied more extensively on an export market for their crop. This export market had declined precipitously following the Unilateral Declaration of Independence (UDI) in 1965, as the white minority government severed political connection with Britain and illegally declared independence. Consequently, in 1966 the United Kingdom Government as a punitive measure started encouraging its manufacturers to boycott Rhodesian tobacco. This witnessed the country's tobacco exports falling drastically by 76 per cent from 120,898 tonnes in 1965 to 28,959 tonnes in 1966 with a corresponding fall of 82 per cent in export receipts from R\$93.9 million to a paltry R\$16.7 million.¹⁵⁷ Thus, when news reached Rhodesia that most European countries (particularly West Germany, which had become an important export market for Rhodesian leaf after UDI) were planning to ban the import of tobacco treated directly or indirectly with DDT or other hydrocarbon insecticides, it was

152 The Rhodesian Veterinary Association had written to the Secretary of Health on 13 January 1970 voicing their concerns about the accumulation of pesticide residues in animal tissues used for human consumption. They noted that they had a collection of results from samples already analysed that showed high levels of such residues.

153 National Council of Rhodesian Women to Minister of Health, 10 May 1970. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

154 This was legislated for under the Hazardous Substances Act of Southern Rhodesia (1973).

155 Ron Thomson, ‘DDT: The Resurrection of an Old Threat to Africa's Wildlife’, www.africahunting.com/threads/ddt-the-resurrection-of-an-old-threat-to-africa%E2%80%99s-wildlife.14737/, accessed 12 July 2018.

156 The situation was different for other crops. For instance, the maize export consumer market was not making the same demands as the tobacco consumer market regarding pesticide contamination regulation, and also maize was largely grown for domestic consumption and was not a major export crop in Rhodesia.

157 Rowe, *Manipulating the Market*, 74.

imperative that they act promptly. From 1965, the TRB had operated an ill-defined and inchoate pesticide evaluation system. The scheme was largely voluntary and pesticide evaluation was done sporadically only for those growers who opted to be part of the pesticide monitoring program.¹⁵⁸ There was also no technical and legal infrastructure for a comprehensive mandatory pesticide control scheme. The scheme, however, made some minor headway in eliminating some chemicals with unwanted residues that were on the list of recommended pesticides. At the end of July 1970, heptachlor and dieldrin, which were recommended applications for the soil, had been dropped in favour of aldrin, which was less persistent and resulted in lower levels of residue.¹⁵⁹ In addition, any recommendations for the application of DDT to the leaf in the field was eliminated and replaced by monocrotophos—a systemic poison (now banned for use in the country).¹⁶⁰ The international trends and opinions on DDT use and the need to give assurances to overseas buyers, however, played a bigger part in the setting up of the tobacco pesticide control infrastructure, more than any local concerns about curbing contamination of the environment or human poisoning. The scheme certainly eliminated unacceptable levels of residues from the export leaf but did little to control or even monitor the use of these chemicals on tobacco farms, and the accompanying human and natural hazards. It was a scheme based on the commercial interests of the Rhodesian tobacco industry. The environmental aspect of the program was merely a smokescreen.

By September 1970 the key tobacco stakeholders in Southern Rhodesia considered that the best way to monitor the use of pesticides and create a deterrent in time for the 1970–71 crop would be by means of a random sampling on the tobacco sales floors before selling took place.¹⁶¹ They agreed on the need to set up legislation to enable this and ensure the confidence of the importing countries. They also agreed that the Tobacco Industries and Marketing Board (TIMB) would invoke the powers of the Tobacco Marketing and Levy Act to prohibit the sale of tobacco that had been treated with aldrin, dieldrin or heptachlor.¹⁶² Where the levels of pesticide residues were above the permitted tolerances, or banned pesticides were detected, a full-scale investigation of the remainder of the crop on the farm would ensue.¹⁶³ An analytical unit worth R\$7,000 and running costs of R\$400 monthly was proposed as a preliminary budget.¹⁶⁴ The TIMB noted with concern that although DDT was still recommended, it was highly suspect and there was a need to monitor its continued use to ensure that the West German standard of one part per million (ppm) was not exceeded.¹⁶⁵

158 Tobacco Research Board, 'Pesticides Use on Tobacco: A Review of International Trends and their Impact on Rhodesian Production', Memorandum, 31 August 1970.

159 *ibid.*

160 *ibid.*

161 Minutes of the Meeting on Pesticides on Tobacco held on 4 September 1970. 42-12-5F, Box number 126962, Pesticide control legislation. NAZ.

162 *ibid.*

163 *ibid.*

164 *ibid.*

165 *ibid.*

The TRB also admitted that it had evidence of the presence of DDT in quantities in excess of this standard as a result of drift from cotton spraying.¹⁶⁶ By August 1970, the TRB had begun raising red flags over the use of DDT within tobacco grading and storage buildings, calling for a suitable replacement for pest control in stored tobacco.¹⁶⁷ Its director, Ian McDonald, agonised that ‘there is a real danger of contamination of exposed leaf following contact with treated walls and floors’.¹⁶⁸

Consequently, the Tobacco Pesticide Contamination Investigation Committee came into being in 1970 under the chairmanship of Mike Butler, President of the Rhodesian National Farmers Union, to consider all aspects of chemical contamination arising from crop spraying and to regulate the use of DDT and other banned substances.¹⁶⁹ Representatives on the committee included RTA, the Department of Conservation and Extension, TRB and the cotton and grain commodity associations. The RTA noted that the purpose of the committee was to ensure that tolerance of toxic residues in tobacco remained lower than defined by legislation in other countries.¹⁷⁰ The Tobacco Marketing and Levy General Amendments Regulations Notice No. 3 of 1970 banned the use of DDT and other pesticides¹⁷¹ for field applications, but as a result of lack of satisfactory alternatives its use was retained in seedbeds and as a soil treatment following transplanting.¹⁷² These control measures were adjudged to have been effective in containing the contamination of the tobacco leaf destined for export, so much so that in 1972 the Report of the TIMB gloated glowingly that growers were using pesticides responsibly and every case of contamination was now proved to have arisen from accidental causes, either from applications in farm buildings before the introduction of the regulations in 1970, or from drift during aerial spraying.¹⁷³ The report further noted that as a result of investigations only four flue cured and 10 burley crops were partially or entirely embargoed, resulting in the loss of 70,000 kg of tobacco.¹⁷⁴ By 1974, DDT had been ‘eliminated’ (although there were actually still sporadic incidences of its use despite the comprehensive ban) from tobacco production in Rhodesia and replaced by a new insecticide Neotox, which the TRB said could be used ‘more safely and effectively than DDT’.¹⁷⁵ It was also less persistent and less dangerous to wildlife, with a low dermal and inhalation toxicity.¹⁷⁶

166 *ibid.*

167 *ibid.*

168 Ian McDonald to Head Branch of plant protection, 13 August 1970. 42-12-5F, Box number 126962, Pesticide Control Legislation. NAZ.

169 ‘Committee to Investigate Pesticide Contamination’, *Rhodesian Herald*, 13 November 1970.

170 *ibid.*

171 The other banned pesticides under the Government Notice included TDE (tetrachlorodiphenylethane), benzene hexachloride, CIC, dieldrin, arsenic, Mendrin, endosulfan and aldrin. The ban was to come into use as soon as existing stocks in the shops were finished and these were expected to last until the end of the season.

172 Southern Rhodesia Government Notice No. 3 (1970).

173 Tobacco Industries and Marketing Board, *Annual Report* (December 1972).

174 *ibid.*

175 ‘New Tobacco Pest Control’, *Rhodesian Herald*, 14 June 1974.

176 *ibid.*

While the TRB pest control scheme played a greater part in limiting contamination of the tobacco export leaf on the white farms, the utility of this program was a little weaker amongst black African burley tobacco growers in the Tribal Trust Lands (TTLs). Amongst most African growers, DDT was being used indiscriminately, despite the 'ban' on its use on tobacco. In September 1975, the Acting Agricultural Director of the TTLs, A. M. Coleman, wrote to the Provincial Agricultural Officer, Mashonaland West and Central, complaining about undesirably high levels of DDT found in leaf samples taken from African farmers in Mount Darwin, Karoi and Glendale.¹⁷⁷ During a meeting of the pesticide committee, the TRB director echoed this concern and observed that, as far as the TTL growers were concerned, there had not been much improvement, and in fact there had been some slight deterioration.¹⁷⁸ He pointed out that as long as DDT was still available to the black African grower he would continue to use it as *muti* (meaning 'magical medicine', referring here to a disinfectant chemical), and a great deal of African tobacco was stored in *kias* (African huts), which would have been dosed with DDT as a means of killing various household pests, including mosquitoes.¹⁷⁹ In addition, the use of the product by African farmers to spray their cotton caused problems of drift. The worst offenders in this regard were mentioned as the black farmers in the TTLs of Chiweshe and Chesa (see Figure 2).

To control the problem, the Secretary of Internal Affairs proposed the prohibition of purchases of 85 g packets of DDT in African areas.¹⁸⁰ This he viewed as effective since white farmers could buy this insecticide only in bigger packages of 1 kg or 50 kg.¹⁸¹ Although DDT was still being used by both white and black cotton farmers for the control of bollworms, the concern was that burley tobacco was being accidentally contaminated by drift from cotton spraying in black African areas. The secretary of the Agricultural Pesticides Association pointed out that DDT was a cheaper alternative for the spraying of cotton, and to keep the spraying costs of African cotton within bounds, DDT still had to be used.¹⁸² The problem, he noted, could only be solved by better extension advice and the right educational approach to the cotton grower rather than the removal of the pesticide from the market.¹⁸³

177 Coleman to Provincial Agricultural Officer, Mashonaland West and Central, 15 September 1975. S3700/44, Crop Pests Control, Use of Pesticides and Herbicides, October 1973–March 1977. NAZ.

178 Minutes of the Pesticide Control Committee held at the RTA (Salisbury), 13 October 1975. Crop Pests Control, Use of Pesticides and Herbicides, October 1973–March 1977. NAZ.

179 *ibid.*

180 Secretary of Internal Affairs to Secretary Agricultural Pesticides Association, 8 March 1976. S3700/44, Crop Pests Control, Use of Pesticides and Herbicides, October 1973–March 1977. NAZ.

181 *ibid.*

182 Secretary Agricultural Chemicals Industry (Mrs. P. A. Morgan) to Ministry of Internal Affairs, 4 May 1976. S3700/44, Crop Pests Control, Use of Pesticides and Herbicides, October 1973–March 1977. NAZ.

183 *ibid.*

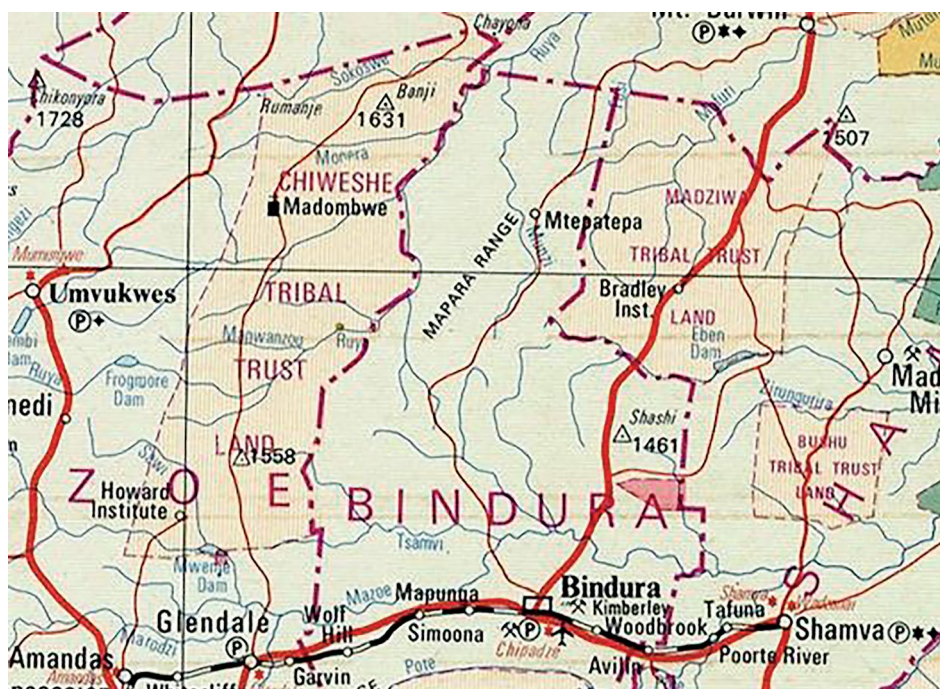


Figure 2: Tribal Trust Lands, Mashonaland North, Southern Rhodesia.

Source: www.rhodesiansoldier.com/hist-bush-war-op-overload.html, accessed 20 September 2019.

In 1974, 28 per cent of African-grown burley that was sampled by the Pesticide Control Committee revealed higher DDT residues (Tables 1 and 2). In 1975, the figure went up to 31 per cent, but what was more worrying was the presence of much higher residues of over 2 ppm, constituting 15 per cent of the sample. In the white areas, the levels of contamination were remarkably lower. In 1974, for instance, out of a sample of 77 growers only two, 6.5 per cent, had crops with high levels of DDT, and in 1975 while 345 kg of black African tobacco was destroyed for containing higher levels of DDT, amongst the European growers no tobacco was destroyed.¹⁸⁴ All in all, these comparative results reflect that there was heavier contamination by DDT in the TTLs that were black African areas. This contamination certainly left residues in the environment and food crops grown on the adjacent pieces of land as black African plots in the TTLs never exceeded 2 acres at most.¹⁸⁵ Unfortunately, this racialised dimension was never considered by the Tobacco Pesticide Scheme and the level of contamination of food crops, land and water in the TTLs by DDT can only be inferred from scientific evidence made available by later studies. A 1999 scientific study on samples from soil, rivers and dams found DDT residues in the

184 Tobacco Industries and Marketing Board, Monitoring Service for Pesticide Residue in Tobacco, 'Pesticide Inspectors Report to the General Manager (TIMB)', 10 October 1975.

185 The Tribal Trust Lands were largely overcrowded and a result of colonial racialised land policy that began with the 1930 Land Apportionment Act, which set up prescribed areas for African settlement.

terrestrial environment of the former TTLs of Mount Darwin and Rushinga, which was attributed to cumulative contamination over 20 years.¹⁸⁶ What this does reveal is how Carson's environmentalism operated unevenly along the lines of race and class in Southern Rhodesia, impacting black Africans and whites in distinctively different ways.

Table 1: Pesticide contamination of burley tobacco in African areas, 1974.

DDT amount	Number of growers	Growers as a percentage
Less than 0.5 ppm	94	51.4
0.5–0.9 ppm	15	8.4
1.0–1.5 ppm	37	20.2
1.6–2.0 ppm	16	8.0

Source: Rhodesia Tobacco Marketing Board, Monitoring Service for Pesticide Residue in Tobacco: Report of Burley Sample, Tribal Trust Lands, 1974.

Table 2: Pesticide contamination of burley tobacco, African areas, 1975.

DDT amount	Number of growers	Growers as a percentage
Less than 0.5 ppm	66	50.5
0.5–0.9 ppm	25	19.0
1.0–1.5 ppm	11	8.5
1.6–2.0 ppm	9	7.0
Over 2.1 ppm	20	15.0

Source: Rhodesia Tobacco Marketing Board, Monitoring Service for Pesticide Residue in Tobacco: Report of Burley Sample, Tribal Trust Lands, 1975.

In the final analysis, the major lesson that can be drawn from the Tobacco Pesticide Control Scheme is that it was rarely about the safe use of chemicals to avoid environmental contamination and human poisoning. Instead, the scheme was about avoiding the contamination of the tobacco crop for the export market. Even then, by 1970, most farmers were unwilling to spend money on extending pesticide protection to include the safety of their labourers because of the costs involved. Increasing agricultural safety was estimated to cost farmers as much as R\$2.1 million in 1971.¹⁸⁷ In 1972, the 'Kutsaga suit' was developed by the TRB for the safe and efficient application of pesticides to burley tobacco.¹⁸⁸ This was a more effective suit than the protective suits available at the time of the jacket-and-trousers type that were not adequately protective against small particle penetration.¹⁸⁹ Despite this, most farmers were still not actually adopting safety practices for agricultural labourers using sprayers. The Ministry of Health in 1978

186 Mbamba and Zaranyika, 'DDT Residue in Terrestrial Environment'.

187 'New Safety Rules May Give Farmers a Shock', *Rhodesian Financial Gazette*, 15 January 1971.

188 'Applying Insecticides with a Knapsack Mist Blower', *Tobacco Forum of Rhodesia*, August 1972.

189 *ibid.*

fretted that some Rhodesian farmers were far too casual with the use of highly toxic pesticides.¹⁹⁰ They noted that labourers using knapsack sprays were not protected against the chemicals used. Tanks were often refilled while still on the operator's back, and unless he was wearing protective clothing spillage would take place, which would mean the chemical would be in contact with his skin.¹⁹¹ As a result, several incidences of poisoning were reported.

A spokesperson for the government's Occupational Safety and Compensation Department said that from April 1977 to March 1978 more than 100 cases of poisoning were reported. Of these, 24 involved pesticides, with 22 occurring in agriculture.¹⁹² The spokesperson added that many more cases amongst black African agricultural labourers went unreported.¹⁹³ In one horrifying case, an African labourer was spraying pesticide on a tobacco crop in the Salisbury area when the hose became clogged. He tried to clear it by sucking with his mouth, leading to him swallowing the solution and dying.¹⁹⁴ In another case, African labourers were spraying chemicals on a tobacco crop at Kutsaga Research Station. The wind suddenly changed direction, blowing the toxic droplets into their unprotected faces, causing severe burns.¹⁹⁵ In yet another case, an African family was working on a tobacco farm where pesticide and water were stored in similar drums. A small daughter of the family drank from the wrong barrel and died.¹⁹⁶ In most instances, tobacco farm labourers exercised very little caution when using harmful chemicals as a result of ignorance. According to the testimony of one former farm worker, water containing DDT would be drunk by thirsty labourers, and some would even consume their food with unwashed hands after handling highly toxic organophosphate chemicals in tobacco nurseries, and there was very little concern on the part of the white farmers.¹⁹⁷ A survey by the Hazardous Substances Inspectorate group of 378 farms revealed shockingly that less than half throughout the country did not provide protective gear for their workers and on 72 per cent of the farms none of the workers interviewed knew the meaning of the purple and red triangle emblems on pesticide containers!¹⁹⁸ Thus while the use of poisonous chemicals in agriculture was increasing, there were no

190 'New Control on Pesticides', *Rhodesian Financial Gazette*, 3 March 1978.

191 *ibid.*

192 'Poisonings Caused by Careless Handling', *Rhodesian Sunday Mail*, 18 December 1979.

193 *ibid.*

194 *ibid.*

195 *ibid.*

196 *ibid.*

197 Interview with Mrs Saizi (former farm worker, 74 years old), Westbury Farm, Centenary, Zimbabwe, 13 February 2019. Other former farm workers interviewed (Mr Ganizani, 68 years old, Westbury Farm, Centenary; Mr Kavhimbo, 71 years old, Mutwa Estate, Mount Darwin; and Mr Jimu, 63 years old, Avalon Farm, Centenary) narrated horrendous tales of how chemical poisonings were common on the tobacco farms and resulted in the death of several workers, particularly those who worked in the tobacco nurseries, who often developed chronic conditions like tuberculosis, and eventually died after long illnesses. They also testified that protective clothing was not always provided, and in most cases farm workers sprayed these chemicals while exposed to drift spray.

198 'Farm Workers Exposed to Killer Sprays, Says Survey', *Sunday Mail*, 15 April 1983.

training facilities to teach black farm workers how to protect themselves, resulting in a high incidence of poisoning. Between January 1980 and July 1981, more than 120 cases of organophosphate poisoning were recorded on the white farms around Harare only, and the victims were all black Africans!¹⁹⁹ On 10 July 1984, 12 tobacco farm workers from a farm in Centenary were admitted at Mvurwi District hospital and later transferred to a Harare hospital with organophosphate poisoning.²⁰⁰ Upon inspection of the premises where the workers had been poisoned, the health assistant found:

Five dangerous chemicals lying about on the shelf in a workshop where they should have been locked away. On the same shelf as the poisons they found cups and a tea-pot as well as two mealie cobs. On the veranda of the workshop were a lot of other chemicals, new stock and old stock which were open.²⁰¹

These sporadically reported instances of human poisoning on the tobacco farms are just a few of the many instances of the liminal losses and unseen sufferers that Nixon has argued are under-represented in both strategic planning as well as historical memory.²⁰² This marginalisation of the casualties of chemical poisoning is largely a result of what Mike Davis calls 'the dialectic of ordinary disaster', where a calamity is appropriated into history and made ordinary and forgettable because the burden of risk falls on the unsheltered poor.²⁰³ Consequently, most such disasters are expunged from historical memory and policy planning by their framing as 'accidental and random'.²⁰⁴ To this extent, therefore, the official figures on chemical poisoning of African labourers in Southern Rhodesia must be treated with scepticism.

Also, while the pesticide control scheme focused on the contamination of tobacco by these chemicals, many of them were still being used indiscriminately for other agricultural purposes, mostly within white farming areas. A scientific study carried out in 1972 covering most parts of the country revealed a massive build-up of DDT in lakes.²⁰⁵ Many cases of fish poisoning by DDT, dieldrin, empty methyl bromide tins and tobacco scrap were also reported in most ICAs.²⁰⁶ Reports were also published in the *Rhodesian Herald* (17 and 19 December 1975) on the use in the tobacco-producing districts of Karoi and Sinoia (see Figure 1) of non-selective poisons during a rodent plague, resulting in deaths all along the food chain, including

199 *ibid.*

200 'Poisonous Chemicals Threaten Farm Workers', *The Herald*, 12 November 1984.

201 *ibid.*

202 Nixon, *Slow Violence and the Environmentalism of the Poor*, 2.

203 Mike Davis, 'Los Angeles After the Storm: The Dialectics of Ordinary Disaster', *Antipode* 27 (1995): 221–4.

204 Nixon, *Slow Violence and the Environmentalism of the Poor*, 65.

205 R. J. Phelps and T. Billings, 'Pesticide Levels from Animals in Southern Rhodesia', *Transactions of the Rhodesia Science Association* 55 (1972): 6–9.

206 'Wildlife Must be Conserved', *Tobacco Today*, December 1974.

natural predators such as owls and snakes.²⁰⁷ The Director of National Parks expressed concern over the use of highly toxic and long-lasting poisons as warfarin and Nuvacron (also known as monocrotophos, a systemic tobacco pesticide) for the field control of rodents in the white farms.²⁰⁸ In March 1975, J. J. Buitendag, the MP for Mhangula (another tobacco-producing district), wrote to the Minister of Lands and Agriculture complaining that farmers were using various poisons to combat rats and mice that were digging up and eating their maize seeds, and many predators were killed as a result.²⁰⁹

While forms of control had been established for the use of pesticides on tobacco and other crops, there were inadequate environmental control and policing mechanisms. Dr Hamilton Ritchie (a member of the Rhodesian Legislative Assembly) had posed the very ‘Carson-esque’ question to the Minister of Health in 1978 of whether he was satisfied with the policing systems stopping farmers from using too much pesticide, which could then wash off into rivers and be detrimental to animal welfare and the biological chain.²¹⁰ The minister responded that it was difficult to control the amount of pesticides farmers put onto their crops.²¹¹ Cognisant of these problems, the NRB had created the Environmental Conservation Committee in November 1977 under the chairmanship of Professor Geoffrey Bond. The committee considered pesticide and herbicide usage in the country in detail, in particular that of DDT, by taking evidence from local ‘experts’ and informed by the global trends.²¹² During the same period, a number of local studies had begun to confirm through scientific data that DDT contaminated the environment.²¹³ The interim report of the Environmental Conservation Committee was the first comprehensive official study on the effects of pesticide poisoning on the environment in Southern Rhodesia.²¹⁴ The report was presented to the new government of independent Zimbabwe in late 1980. The new political context had little influence on the report as its findings were compiled over a long period of time. The report concurred with the global data that pesticide residues could accumulate in the environment, creating an insidious effect on the ecosystem.²¹⁵ It pointed out that although the threat to human life within the

207 *Rhodesian Herald*, 19 December 1975.

208 *ibid.*

209 J. J. Buitendag to Minister of Lands and Agriculture, 5 March 1975. S3700/44, Crop Pests Control, Use of Pesticides and Herbicides, October 1973–March 1977. NAZ.

210 ‘Control Over Pesticides Difficult’, *Rhodesian Herald*, 29 November 1978.

211 *ibid.*

212 Under the supervision of the Ministry of Agriculture, a nationwide pesticide monitoring program was started in 1979 to determine whether residues of chlorinated hydrocarbon poisons were present in dangerous quantities in the country. This came after repeated calls by conservationists for the banning of pesticides that had been recognised as dangerous to humans and wildlife. The monitoring program was being carried out by the Ministries of Health, Agriculture and National Parks and Wildlife through sampling of water bodies, water life and soil.

213 Y. A. Greichus et al., ‘Insecticides, Polychlorinated Biphenyls and Metals in African Lake Ecosystems II: Lake Mcllwaine, Rhodesia’, *Bulletin of Environmental Contamination and Toxicology* 19 (1978): 444–53, doi.org/10.1007/BF01685824.

214 Natural Resources Board, ‘The Pesticide Dilemma’, *Newsletter* no. 8 (September 1981).

215 *ibid.*

country had been negligible, there had been human fatalities through accidental overdose and suicide. In addition, certain bird species had been endangered.²¹⁶ The report further exhorted the NRB to consider the matter dispassionately from the point of view of what was best for the country.²¹⁷

The report by the Environmental Conservation Committee thus confirmed what had already been articulated by sporadic official voices in Southern Rhodesia, including the Ministry of Health, since 1969 about the effects of pesticide residue on humans and the environment. A parallel can be made between the significance of the report and that of the American PSAC 1965 report, as it goaded the pesticide control agenda into the official policy corridors and called for relevant monitoring instruments, particularly through the NRB. For its part, the NRB noted that it was deeply concerned about the continued use of DDT in light of the adverse reports emanating from other parts of the world, mostly the developed world, in which several countries had banned this pesticide. It was concerned about the general misuse of pesticides and herbicides in the country, particularly the spraying of monocrotophos at two or more times the rate recommended for aphid control in tobacco for which it was registered.²¹⁸ The board noted that the pesticide was lethal to game birds such as guinea fowls, and a host of other birds, and as a result there had been a serious depletion of birdlife in some tobacco farming areas.²¹⁹ This perhaps evokes the eerie silence captured poetically by John Keats in 'La Belle Dame sans Merci', from which *Silent Spring* takes its title, two lines of which read:

The sedge is wither'd from the lake,
And no birds sing.²²⁰

From the 1980s, following the end of white colonial rule, the use of DDT fell under severe scrutiny in Zimbabwe, largely because of the build-up of evidence on its residual effects on wildlife and the environment. In 1982, the widespread use of DDT as an agricultural insecticide was banned by the newly independent government.²²¹ In 1985, DDT was declared a Group 1 hazardous substance, and its use was restricted to research purposes for malaria and tsetse fly control.²²² By 1991, it had been banned for outdoor control of malaria because of concerns over the contamination of tobacco.²²³ Currently, DDT is being used only for indoor malaria

216 *ibid.*

217 *ibid.*

218 *ibid.*

219 *ibid.*

220 John Keats in M. H. Abrams, *The Norton Anthology of English Literature*, vol. 2 (New York: W. W. Norton and Co., 1970).

221 S. M. Mpofu, 'DDT and its Uses in Zimbabwe', *Zimbabwe Science News* 21 (1987): 31–6.

222 M. E. S. Flint and M. J. S. Harrison, 'DDT Impact Assessment Project: Zimbabwe', *Department of International Aid, Evaluation Report*, no. 621 (December 1998): 9.

223 *ibid.*

control in the country.²²⁴ However, concerns over the contamination of tobacco as a result of indoor DDT spraying have resurfaced in recent years, particularly with the entry of many black farmers into production after the chaotic Fast Track Land Reform Programme in 2000.²²⁵ In 2018 there were concerns that the country's tobacco would face a ban over DDT residue contamination. Research findings by global tobacco merchants presented at the Cooperation Centre for Scientific Research Relative to Tobacco (CORESTA) showed that, of all producing countries, Zimbabwean tobacco was the only one contaminated by DDT.²²⁶ Other highly toxic insecticides such as monocrotophos (warfarin and Nuvacron) and methamidophos (Tamaron) were banned for use in tobacco, but they have continued to be used by most black smallholder producers as they are easily available on the black market and cheaper than the recommended alternatives.²²⁷

Conclusion

The history of pesticide use in Southern Rhodesia is a story of environmental pollution and contamination that has never been studied before by historians. Yet it is evident that the use of these chemicals posed serious hazards. Irresponsible and casual use of pesticides, because of lack of proper pest management and safety facilities, claimed a significant number of silent and silenced casualties—in both the human and natural environment. The story of this 'slow violence' and invisible deaths in tobacco farming does indeed conjure up Carson's *Silent Spring*. In fact, the local narrative connects with the global movement that Carson stirred, which brings us back to the question we asked at the start: was there an African Rachel Carson? An engaged understanding of Carson in Africa needs to be understood in tandem with the triple concepts of 'slow violence', the 'environmentalism of the poor' and 'environmental racism', as we have argued. But this should not be an historiographical ending, rather a beginning of the quest for the African Carson moment. This paper has not intended to write an environmental history epitaph or to rehabilitate Carson in Africa, but rather awaken an historiographical debate on *Silent Spring* as it relates to Africa. Already it is clear that Southern Rhodesia

224 The current national spraying program is largely funded by USAID under the President's Malaria Initiative Indoor Residual Spraying Project.

225 There are over 165,000 smallholder tobacco producers registered for the 2018–19 season. Some of these producers are in areas that have high incidences of malaria and they use DDT for indoor control. Consequently, their tobacco is contaminated from storage in the sprayed houses.

226 See 'Zim tobacco faces ban over DDT residue contamination', *AgriNews*, 14 December 2018, agrinews.co.zw/crops/2018/14/2153zim-tobacco-faces-ban-over-ddt-residue-contamination/, accessed 25 February 2019 (webpage discontinued).

227 See Doreen Badze, 'Farmers Still Using Banned Pesticide', *The Standard*, 11 December 2016, www.thestandard.co.zw/2016/12/11/farmers-still-using-banned-pesticide/, accessed 25 February 2019. Other tobacco chemicals banned in the country include the soil fumigant methyl bromide, because of its negative effects on the ozone layer, and EDB, which was banned in the United States on 19 September 1983 because it was shown to cause cancer and birth defects.

had its own 'Silent Spring' moment(s), but these moments were idiographic and vernacular encounters within a global environmental movement. While Carson sparked modern environmentalism and brought pesticide use into critical focus, her meaning within Africa must be critically understood within a strongly diachronic context. First, as argued in this paper, *Silent Spring* did not invent environmental consciousness, but rather channelled it into a global environmental zeitgeist. It provided the impetus and vocabulary for a new kind of challenge post-1960. Second, this movement assumed new meanings and forms in Africa, where unique problems of technical innovation in agriculture, costs of harnessing new pest control management systems, economic and political inequalities, and the more hostile pest-prone climatic conditions required pragmatic approaches to pesticide control. To this end, the 'African Rachel Carson moment' must be seen as a vernacular experience drawing inspiration from its own local and global realities. Even in the United States, there never was a monolithic and homogenous 'Silent Spring'. Rather there were several silent springs. Finally, we must guard against the dangers of reading Carson in Africa in teleological terms; as historians, just as much as we need to reconstruct knowledge, we need to painstakingly reconstruct ignorance.

BIOFUELS' UNBALANCED EQUATIONS: MISLEADING STATISTICS, NETWORKED KNOWLEDGE AND MEASURED PARAMETERS: PART 2. NETWORKS, CONSENSUS AND POWER¹

KATE B. SHOWERS

Centre for World Environmental History
University of Sussex

Abstract

The independence of claims that biofuels can mitigate climate change is assessed using environmental history. The development of professional and institutional networks that produced both energy demand models and soil, land and terrain databases and models is traced, and the acquisition of significant unacknowledged social power is examined. Data literacy's critical perspective identified sources of embedded distortions, unacknowledged bias and inherent weaknesses. Claims of the robustness, accuracy, objectivity and originality of globalised analyses in general, and global biofuels projections in particular, are challenged. The effectiveness of policy based upon these results is discussed.

Keywords: European Union energy policy, professional networks, climate change, Global Land Cover Characteristics Database (GLCCD), Global Agro-ecological Zones (GAEZ)

Introduction

To what extent are claims that biofuels production can mitigate climate change independent? Academics, multilateral institutions and industry-related groups have released publications asserting that cultivation on an industrial scale will significantly reduce fossil fuel requirements while reducing carbon emissions. These reports also claim a benefit for farmers without causing environmental harm. Manipulation

¹ The author would like to thank the anonymous reviewers for constructive comments and Dr M. K. Sterpka for suggestions.

of globalised statistics has produced quantified justification. Global models have generated maps of regions where large-scale biofuels operations are theoretically possible. The range of analytical techniques and methods employed suggest unique approaches, citations imply broad substantiation, and both presentation style and institutional publication invoke authority.

Overlooked is the fact that analysis at a global scale is not only imprecise by definition, but also dependent upon a small number of information sources. Constructing large globalised data sets and databases is beyond the capacity of most individuals and small groups. However, agencies and institutions with responsibilities for multinational data collection are able to produce databases that are considered to be accurate primary source material. The majority of biofuels production analyses at a global scale rely, in some way, upon similar energy demand models and information from one or more of eight soil, land or terrain tools, databases or models:² the World Soil Map, Soil and TERrain (SOTER) database, *World Agriculture: Towards...* series, Global Assessment of Human-induced Soil Degradation (GLASOD), Agro-ecological Zone (AEZ) methodology and model, Global Agro-ecological Zone (GAEZ) model, *Land Resource Potential and Constraints* report, and TERRASTAT database. They are presented and used as unique sources of information. However, closer examination, particularly of the acknowledgements sections of reports and manuals, reveals linkages through underlying institutional and professional networks.

Collaboration on global databases and models created networks of professionals. The increasingly specialised skills essential for model design and data manipulation and management not only solidified these networks, but also restricted their membership. Globalisation of data reduced the value of, and need for, those well-versed in the detail and variation expressed at finer scales. The shift from finer to coarser scales of analysis could be characterised as a process of continuous exclusion—of people as well as of detail. Those included in the professional networks accumulated social power through their ability to supply data. The expression of this social power is evident in the way in which the intellectual framework of globalisation has guided late twentieth-century and early twenty-first-century soil classification at the country level, as well as analysis of land use at a global scale. Homogenised global data expressed as grid cells obscures, if not denies, local diversity and the importance of local environmental knowledge.

It is, perhaps, time to investigate the structure of globalised models and databases themselves, and pose some questions. Has the narrowed outlook of exclusive professional networks affected the quality of globalised statistics? Has the globalised

2 For detailed database discussion see Kate B. Showers, 'Biofuels' Unbalanced Equations: Misleading Statistics, Networked Knowledge and Measured Parameters. Part I: Evolution of Globalised Soil, Land and Terrain Databases', *International Review of Environmental History* 5, no. 1 (2019): 61–83, doi.org/10.22459/IREH.05.01.2019.05.

statistics' loss of specificity rendered them ineffective as a basis for decision-making? Is it possible that policy and programs based on site-specific information could be more effective than those reliant upon data sets and databases operating models whose results are expressed in terms of grid cells? Such interrogations are far from an academic exercise. The existence of environmental crises at many locations and levels is well documented. Concern, even fear, is expressed by individuals, institutions and governments. Broad agreement exists about the urgency of action, but what to do is not at all clear.

Environmental history's chronological approach provides a vantage point from which to trace the origins and development of databases and models used in biofuels and energy demand analyses. The interweaving and interdependence of individuals and institutions become apparent, as do the influences of technological and ideological change. The following paragraphs will illustrate the network context of energy modelling and recent advances in soil science technologies; the largely unacknowledged social power inherent in database and model construction; and the role of networked data and interlinked referencing in the creation of apparent international consensus. Data quality is/should be a concern of database users. Data quality can be assessed by the approach of data literacy, which involves the critical deconstruction of the origin and meaning of numbers. Applying data literacy concepts led to an examination of embedded biases and poor data quality that moved from data sets to databases and then into models' constituent layers. The focus on networks demonstrates the extent to which apparently independent biofuels analyses are actually built upon interconnected databases, models and analyses by a small group of (primarily) men.

Networked collaboration

It is normal that agencies and institutions formed at the supranational level collaborate with each other on projects with worldwide scope. The creation of globalised statistics and tools for data manipulation and analysis is no exception. Data collected by individual departments and agencies within their areas of expertise are frequently shared to create cross-sectoral secondary databases and analyses with greater scope. Multinational and multilateral institutions function best when staff members have the ability to form interactive professional relationships not only within their department and agency, but also across institutions. In time, professional networks emerge connecting departments and institutions.

Globalised database construction requires collaboration in identifying analytical methods and data sources as well as in choosing how and when to use them. Many models are also products of collaboration and professional networks. The intended model's scope must be agreed upon, followed by the determining of

framework parameters and how they interact. With quantification, an analytical framework becomes a basic model that can be modified subsequently for different applications in response to changing data availability or refined understanding. Models derived from the same base (standard) model constitute a family of models.

The nature of professional collaborative networks changed as late twentieth-century economic globalisation coincided with the rapid expansion of information technology. The analytical shift of scale from national and regional to global levels required new data and data management skills. Because local knowledge is less meaningful in global analyses, the importance and authority of those possessing it were reduced. Instead, a smaller, more homogeneous group capable of summarising, synthesising and presenting data at a supranational scale became influential. This trend, and its weaknesses, can be seen in the construction of energy demand models and land use databases and models.

Modelled energy demand

The 1973 oil crisis prompted European government interest in predicting energy supplies for better national planning. During the following two decades, researchers from both national and multilateral institutions contributed to model construction for energy demand assessment. Institutional collaboration and professional networks were fundamental to their success. Because individual researchers moved among the institutions to further develop a model family, the intellectual pool from which the designs were drawn remained small. The development of two commonly used energy demand model families is described below.

Bertrand Château and Bruno Lapillonne at Grenoble, France's Institut Economique et Juridique de l'Énergie (IEJE) built the base of the Modèle d'Évolution de la Demande d'Énergie (MEDEE) model family for simulating long-term energy demand.³ Lapillonne extended the model in 1978 for Laxenburg, Austria's International Institute for Applied Systems Analysis (IIASA). MEDEE-2 enabled evaluation of a country's long-term energy demand using scenarios constructed from aspects of the nation's social, economic and technological 'evolution'.⁴ It was subsequently modified at Vienna's International Atomic Energy Agency (IAEA) for simulating energy demand in developing countries with a large number of end users. This new version was called the Model for Analysis of Energy Demand (MAED).⁵

3 International Atomic Energy Agency (IAEA), *Model for Analysis of Energy Demand (MAED-2)*, User's Manual Series, 18 (Vienna: IAEA, 2006).

4 Bruno Lapillonne, *Medee II: A Model for Long-Term Energy Demand Evaluation* (IIASA Research Report RR-78-017) (Laxenburg: International Institute of Applied Systems Analysis, 1978), pure.iiasa.ac.at/id/eprint/826/1/RR-78-017.pdf, accessed 11 July 2019.

5 IAEA, *Model for Analysis*.

In 1976, the Paris-based International Energy Agency (IEA) created the Energy Technology Systems Analysis (ETSAP) program. ETSAP supported a consortium of country teams 'to maintain and expand a consistent multi-country energy/economy/environment/engineering (4E) analytical capability'.⁶ Over two decades, this users' group produced the MARKet Allocation (MARKAL) model family. MARKAL models were 'long-term multi-period energy technology optimization models' to analyse issues in energy planning and environmental policy formulation.⁷ The MARKAL model was superseded by The Integrated MARKAL-EFOM System (TIMES) version:

a technology rich, bottom-up model generator, which uses linear programming to produce a least-cost energy system, optimized according to users constraints over medium to long-term horizons.⁸

In partnership with the London-based World Energy Council (WEC), modellers at Villigen, Switzerland's Paul Scherrer Institut (PSI) expanded the MARKAL to the Global Multi-regional MARKAL (GMM-MARKAL). This was a 'technologically detailed model of the global energy system'.⁹ GMM-MARKAL was used in the WEC's 2013 *World Energy Scenarios: Composing Energy Futures to 2050*.

During the 1990s, P. Criqui, Director of Grenoble's Laboratoire d'Economie et de la Production et de l'Intégration Internationale (LEPII)/Institute of Energy Policy and Economics (IEPE, now EDDEN-CNRS) created, in conjunction with the private sector company Enerdata (also in Grenoble), the Prospective Outlook on Long-term Energy Systems (POLES) model. POLES is an econometric, partial-equilibrium world model (equilibrium between supply and demand) for global supply and demand forecasting.¹⁰ Further elaboration continued in France at the Centre national de la recherche scientifique/Université Pierre Mendès-France (CNRS/UPMF), Enerdata, and at Seville, Spain's Institute for Prospective Technological Studies (IPTS).¹¹

6 IEA-ETSAP Community, iea-etsap.org/index.php/community, accessed 29 October 2019.

7 Katholiek Universiteit, *Energy Transport*.

8 International Energy Agency Energy Technology Systems Analysis Programme, 'Times. Overview of Times Modelling Tool', iea-etsap.org/index.php/etsap-tools/model-generators/times, accessed 13 December 2018.

9 H. P. V. Turton, M. Densing and K. Volkart, *Global Multi-regional MARKAL (GMM) Model Update: Disaggregation to 15 Regions and 2010 Recalibration* (PSI Bericht,13-03) (Villigen: Paul Scherrer Institute, 2013).

10 POLES: *Prospective Outlook on Long-term Energy Systems*, www.enerdata.net/solutions/poles-model.html, accessed 29 October 2019; Enerdata, *Forecasting Models*, 2015.

11 Kitou, *POLES Model*.

The MEDEE family has been used in more than 100 countries,¹² and MARKAL models have been applied by many institutions and countries.¹³ POLES was the analytical tool underpinning the Organisation for Economic Co-operation and Development (OECD)/IEA's World Energy Technology Outlook (WETO) series—*World Energy, Technology and Climate Policy Outlook 2030—WETO* (2003); *World Energy Technology Outlook—2050 WETO-H₂* (2006); and the World and European Energy and Environment Transition Outlook—WETO-T,¹⁴ as well as the Quantitative Scenarios of the WEC (2007).¹⁵ Alone and in combination, these models have been used to generate quantified energy demand projected to 2020, 2030 and 2050 at the municipal, national, regional and global levels. The numbers produced vary according to the categories of information (inputs) entered into successive model runs. The results (outputs) are comparable only when the data used have equal validity and the underlying components of the model used are identical—and identically weighted.

Global soil, land and terrain analysis

EU policy makers' identification of biofuels as an economically beneficial response to Kyoto Protocol responsibilities¹⁶ created a demand for global, rather than national, levels of crop production information. This coincided with trends within the soil science community to express soil properties at ever coarser scales. Global biofuels analysis and EU policy formulation relied, directly or indirectly, on one or more of the eight databases and models that characterised, quantified and/or valued soil, land and terrain listed in Table 1: World Soil Map, SOTER, *World Agriculture: Towards...* series, GLASOD, AEZ methodology and model, GAEZ model, *Land Resource Potential and Constraints* and TERRASTAT.¹⁷

12 Enerdata, *Forecasting Models*.

13 Energy Technology Systems Analysis Program, 'MARKAL', iea-etsap.org/index.php/etsap-tools/model-generators/markal, accessed 29 October 2019.

14 B. Château and D. Rossetti di Valdalbero, eds, *World and European Energy and Environment Transition Outlook—WETO-T*, EUR24805EN (Luxemburg: Office for Official Publications of the European Communities, 2011).

15 Enerdata, 'POLES: Prospective Outlook on Long-Term Energy Systems', 2015, www.enerdata.net/solutions/poles-model.html, accessed 11 July 2019.

16 Kate B. Showers, 'Land Use from Below: Biofuels, Urbanization and Sustainable Soil Management in Europe and Africa', in *The Challenge of Sustaining Soils: Natural and Social Ramifications of Biomass Production in a Changing World* (Interdisciplinary Perspectives, 1), ed. Verena Winiwarter and Martin H. Gerzabek (Vienna: Austrian Academy of Sciences, 2012).

17 Their origin and constituent components are discussed in detail in Showers, 'Biofuels' Unbalanced Equations. Part 1'.

Table 1: Eight data sources for global soil, land and terrain analysis.

	World Soil Map	SOTER	World Agri. Towards (series)	GLASOD	AEZ	GAEZ	Land Resource Potential	TERRASTAT
Year	1968–78	1986–93	1970, 1988–2012	1987–89	1978–	2000–	2000	2000–02
Institution	FAO, ISSS, UNESCO	Land Resources Research Centre Canada, ISSS, FAO	FAO	ISRIC, UNEP	FAO, IIASA	IIASA, FAO	FAO	FAO
Profession	soil science, agronomy	soil science, agronomy	economics	soil science, ecology, modelling	soil science, agronomy, ecology, modelling	soil science, agronomy, ecology, modelling	soil science, agronomy	soil science, agronomy
Individuals	International collaboration	van Engelen, Hartemink, Nachtergaele	Alexandratos, Bruinsma	Oldeman, Hakkeling, Sombroek	Nachtergaele, Fischer, van Velthuisen	Nachtergaele, Fischer, van Velthuisen	Bot, Young, Nachtergaele	Nachtergaele
Methods	fieldwork, expert opinion	expert opinion, pedometrics, derivation	expert opinion, supply utilisation accounts, GAEZ	expert opinion, estimates, survey questionnaire	fieldwork, pedometrics, estimates, outlier rejection scheme	estimates, aggregations, derivations, harmonisation, special downscaling, simulation, scenarios, sequential rebalancing	estimates, soil fertility capability classification, preliminary GAEZ v. 1.0	time series, records, expert opinion, derivations, simplification, pedometrics, amalgamation, published GAEZ v. 1.0

Source: The author.

Five institutions were primarily responsible for developing them: the United Nations Food and Agriculture Organization (FAO), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Soil Reference and Information Centre (ISRIC), and IIASA.¹⁸ The UN agencies are so large that constituent departments can operate quite independently of one another. Inter-departmental collaboration can take a form similar to that of inter-agency work.

For example, the creation of the World Soil Map was stimulated by the International Society of Soil Science (ISSS) and guided by an international advisory board whose secretariat was at the FAO. The map was published in collaboration with UNESCO. SOTER, similarly conceived of by the ISSS, was implemented by ISRIC in collaboration with the FAO and UNEP. The *World Agriculture: Towards ...* series was produced by FAO's Economics Division with contributions from other FAO departments and divisions. GLASOD was an ISRIC project implemented with UNEP funding. While the AEZ methodology arose from FAO fieldwork, it was transformed into a database and model family in conjunction with IIASA, which had been involved with the expansion of the MEDEE energy model family. IIASA took the lead in changing AEZ from a field-based tool to the level of global analysis in the form of the GAEZ model family. FAO Land and Water Development Division staff and consultants created the data sets for the *Land Resource Potential and Constraints* report and produced the subsequent TERRASTAT database. With the exception of *World Agriculture: Towards ...*, these eight major projects were led by soil scientists and agronomists and, excepting GLASOD, had significant FAO involvement.

Despite the size of the collaborating institutions, only a few people had leadership roles, or significant influence, in the projects. Together with some consultants, the permanent staff members formed professional relationships that lasted for years, if not decades. These interactions persisted even as individuals moved from one institution to another. The FAO's Economics Division's reports on the prospects for world agriculture (*World Agriculture: Towards...* series) were edited by the same two people for 15 years. As editors, they drew upon all of FAO's departments and divisions for data and expert opinion. However, just as colonial annual reports had often been written by the same officer year after year, framed by the same concepts, and often with identical blocks of text that moved from report to report, the FAO economics series has a continuity of perspective.

18 The International Institute for Applied Systems Analysis (IIASA) is a multilateral institution established in 1972 to bring together researchers from antagonistic nations of the Cold War as a peace-building exercise. Its intellectual purpose was to move beyond academic disciplines through the construction of interdisciplinary teams working at the level of systems analysis (IIASA, 'History of IIASA', 2014, www.iiasa.ac.at/web/home/about/whatisiiasa/history/history_of_iiasa.html, accessed 13 October 2015).

Soil science initiatives similarly engaged a small number of people. From 1978 to 1981, the FAO field staff agronomist Freddy O. Nachtergaele worked with a group that included the modeller Günther Fischer and the land resources ecologist Harrij van Velthuisen to develop and field test the AEZ methodology. When IIASA initiated a Land Use Change project in the 1990s, Fischer was named head. He was assisted by van Velthuisen, initially as consultant, and then as a staff member. The preceding year Nachtergaele had been appointed to FAO's Land and Water Development Division in Rome. Collaborative work continued between Nachtergaele, Fischer and van Velthuisen. First they operationalised the AEZ methodology with a model, then, with expanded data, changed the model to a global scale, GAEZ. Nachtergaele and Fischer are listed as major contributors to Nikos Alexandratos and Jelle Bruinsma's *World Agriculture: Towards ...* publications. Nachtergaele subsequently worked with the agronomist Alexandra J. Bot and the soil scientist Anthony Young to develop a method for assessing the amount and distribution of land suitable for crop production under different levels of management. They used preliminary results of the newly developed AEZ model. The resulting report, *Land Resource Potential and Constraints*, and its tables, were published by FAO in 2000. The tables were modified by application of the completed GAEZ v1.0, and became the TERRASTAT database.

The influence of models on problem definition, analysis and policy formulation is less easily detected. The dominance of two energy model families was discussed earlier. More ubiquitous and, perhaps, insidious is the role of the AEZ–GAEZ model family in land evaluation research and policy analysis. Table 2 lists some apparently diverse and independent papers and reports whose conclusions in some way depend upon a version of the AEZ–GAEZ framework or models. Since the first listed publication date is 1993 and the last is 2015, this model family has been a structural component of the research and analytical framework for more than two decades.

Table 2: Some influential publications using the AEZ–GAEZ model family.

Title	Date	Editor/Author/Team	Institution
Potential Population Supporting Capacities of Lands in the Developing World	1993	Higgins, Kassam, Naiken, Fischer, Shah	Social Development Center, Chicago
Land Resources Potential & Constraints	2000	Bot, Young, Nachtergaele	FAO
TERRASTAT	2001	Nachtergaele	FAO
Farming Systems and Poverty Improving Farmers' Livelihoods In a Changing World	2001	Dixon, Gulliver, Gibbon	FAO/World Bank
Global Bioenergy Potentials Through 2050	2001	Fischer, Schrattenholzer	Biomass and Energy Journal

Title	Date	Editor/Author/Team	Institution
Global Agro-ecological Assessment for Agriculture in the 21st century	2002	Fischer, van Velthuisen, Shah, Nachtergaele	IIASA
Special Report to World Summit on Sustainable Development, Climate Change and Agricultural Vulnerability	2002	Fischer, Shah, van Velthuisen	IIASA
Biomass Potentials of Miscanthus, Willow and Poplar: Results and Policy Implications for Eastern Europe, Northern and Central Asia	2005	Fischer, Prieler, van Velthuisen	Biomass and Bioenergy Journal
World Development Report 2008	2007	World Bank	World Bank
Assessment of Biomass Potentials For Fuel Feedstock Production in Europe	2007	Fischer, Hiznyik, Prieler, van Velthuisen	IIASA
The State of Food and Agriculture Pt I Biofuels: Prospects, Risks, Opportunities	2008	Wiebe et al.	FAO
Awakening Africa's Sleeping Giant: Prospects for commercial agriculture in the Guinea Savannah Zone and Beyond	2009	World Bank	World Bank
Biofuels and Food Security: Implications of an Accelerated Biofuels Production	2009	Fischer, Hiznyik, Prieler, Shah, van Velthuisen	OFID/IIASA
The Resource Outlook to 2050: By How Much Do Land, Water Use and Crop Yields Need to Increase by 2050?	2009	Bruinsma	FAO
Scarcity and Abundance of Land Resources: Competing Uses and Shrinking Land Resource Base	2010	Fischer, Hiznyik, Prieler, Wiberg	FAO
Biofuels: A New Methodology to Estimate GHG Emissions from Global Land Use Change	2010	Hiederer, Ramos, Capitani, Koeble, Blujdea, Gomez, Muligan, Marelli	Office for Official Publications of the European Communities
The State of the World's Land and Water Resources for Food and Agriculture: Management Systems at Risk	2011	Koohafkan et al.	FAO & Earthscan
Compendium on Methods and Tools to Evaluate Impacts, Vulnerability, and Adaptation to Climate Change	2014	UN Framework Convention on Climate Change	UNFCCC
World Energy Outlook	2014	IEA	IEA
Bioenergy and Sustainability: Bridging the Gaps	2015	Souza, Victoria, Joly, Verdade (eds)	Scientific Committee on Problems of the Environment

Source: The author.

As described in detail in Part 1 of this series, Nachtergaele, one of the designers of the AEZ–GAEZ model family, was involved with the development of soil classification tools and databases such as pedometrics, the Digital Soil Map of the World and Derived Soil properties, the World Reference Base for Soil Resources, the Regional Update of World Soils Information and the World Reference Base for Soil Resources. They all underlie the items listed in Table 1.

Network power

The preceding sections demonstrate that small groups of predominantly European men collaborating from within a few supranational institutions were responsible for—or contributed significantly to—projections of not only world-wide energy demand, but also the core concepts, databases and literature underpinning globalised debates about soil and landscape availability and capacities for biofuels.

The Old Boys' Club is a popular expression of the idea of a group with limited admission whose members, located in different institutions, have disproportionate influence on, and power within, larger social structures. Identifying such groups as social networks is not new. Nor is the idea that expertise is associated with specialised occupations. Bureaucratic professionals reinforce their authority as experts through their ability to provide data in support of their recommendations.¹⁹ Interest in the role of professional networks in general, and scientific expertise in particular, was refocused with the rise of global communication structures and late twentieth-century globalisation. There are, however, intellectual and actual linkages to past world experiences with intercontinental systems.

Historians have examined the role of professional networks and scientists associated with imperial expansion. Richard Grove (1995) traced the origins of current environmental concerns and proposed responses to the perceptions and influence of scientists and their networks in the seventeenth- to nineteenth-century European colonial systems. Showers reviewed the creation of the British Colonial Office and its expansion from 1900 to 1930.²⁰ During this time, the notion of 'native peoples' with separate needs became the frame for considering the colonies.²¹ For almost 40 years, Ralph Furse and his brother-in-law Francis Newbolt selected each colonial officer,

19 C. A. Bowers, *Let Them Eat Data: How Computers Affect Education, Cultural Diversity and the Prospects of Ecological Sustainability* (Athens, GA: University of Georgia Press, 2000), 74.

20 Kate B. Showers, 'Erosion Awareness and International Agricultural Bureaucracies: Britain, the United States and Southern Africa, 1900–1930', in *The Forest and Environmental History of the British Empire and Commonwealth* (Delhi: Primus Books, forthcoming).

21 Joseph Morgan Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacy of British Colonialism* (Athens, OH: Ohio University Press, 2007); J. M. Lee, *Colonial Development and Good Government* (Oxford: Clarendon Press, 1967).

primarily from British public schools (prefects and sportsmen)²² and universities.²³ After 1920, and until 1942, Furse assigned his colleague, Greville Irby, to make all of the appointments to the scientific branches—agricultural, forestry, veterinary—and, later, to areas such as the meteorological services.²⁴ Environmental historians have, in accounts of specific places in shorter time frames than Grove, identified the influence of scientists and their networks on the spread of ideas about conditions in the colonial world and how to respond to them.

Joseph M. Hodge examined British late colonial development doctrine from the perspective of the networks of specialist advisers, scientific researchers and technical experts.²⁵ He identified the growing confidence in the use of science and expertise as a distinct feature of twentieth-century British colonialism. With origins in the interwar years, professional networks grew and the concept of expert opinion as objective information developed. That a coherent British colonial world view and professional networks were encouraged, if not consciously constructed, is illustrated by the Corona Club. The Secretary of State for the Colonies, Joseph Chamberlain, created it in 1900 for ‘past and present members of the Colonial Office, the Colonial Service and the Crown Agent’s Office’.²⁶ Its sole purpose was to hold an annual dinner ‘with minimal formalities’ so that officers (and their wives) might socialise with each other and meet the Secretary of State for the Colonies informally. In 1900 membership was 300, growing to 3,500 by 1938.²⁷ Hodge documents the legacy of colonial conceptions that framed institutional world views of ever-present crises and strategies for mitigation, if not resolution, that persisted into the twenty-first century. International aid institutions created after the Second World War were guided, and in some cases (FAO, UNESCO) initially directed, by members of colonial professional and scientific networks.²⁸

The political role of professional and scientific networks, as well as of non-governmental organisations (NGOs), coalesced in the lead-up to the 1992 Rio Earth Summit. According to Mary K. Sterpka, academics noted the influence of these non-state actors in political debates about environmental concerns, which resulted in the advance of influential treaties such as the Basel Accords and the Montreal

22 David Killingray, ‘Colonial Studies’, in *The British Intellectual Engagement with Africa in the Twentieth Century*, ed. Douglas Rimmer and A. H. M. Kirk-Greene (New York: St Martin’s Press in association with the Royal African Society, 2000), 43.

23 Ralph Furse, *Aucuparius: Recollections of a Recruiting Officer* (London: Oxford University Press, 1962), 66; Marjorie Perham, introduction to Robert Heussler, *Yesterday’s Rulers: The Making of the British Colonial Service* (Syracuse, NY: Syracuse University Press, 1963), xvii.

24 Furse, *Aucuparius*.

25 Hodge, *Triumph of the Expert*.

26 George V. Fiddes, *The Dominions and Colonial Office* (London: Putnam and Sons, 1926); W. E. Simnett, *The British Colonial Empire*, 2nd ed. (London: George Allen and Unwin Ltd, 1949).

27 Charles Jeffries, *The Colonial Empire and its Civil Service* (Cambridge: Cambridge University Press, 1938), 13–14.

28 Hodge, *Triumph of the Expert*, 19.

Protocol.²⁹ Peter Haas identified these 'networks of knowledge-based experts' as epistemic communities. Their members operated with shared values, normative beliefs and shared goals.³⁰ The role of epistemic communities in guiding politicians strengthened in the late twentieth century with the recognition of the increasing numbers and complexity of environmental problems facing humanity. Haas, and later Mai'a Cross,³¹ argued that when states and institutions are confronted with uncertainty or crisis, there is an increased demand for the authority and expertise inherent in these networks. Politicians looked to epistemic communities for simplified answers, including explanatory diagrams and models. Cross proposed that the importance of epistemic communities increased with globalisation.³²

Networking was central to the many transitions that resulted in economic globalisation. The interactions among and between networks created what Manuel Castells named 'network societies'.³³ In his analysis, information is a kind of currency. Networked individuals became 'knowledge workers' who generate power through their ability to handle information, to model and to project their world view. This manufacture and control of information increases the knowledge workers' political credibility, which contributes to the gravitation of power from nation states to networks. One aspect of this control of information is the exclusion of the global South from processes of decision-making.

The system of economic globalisation that emerged in the late twentieth century was made possible by, and was dependent upon, the emerging digital communications technologies. From a technical perspective, David Grewal discusses the power inherent in the physical construction of these communications systems.³⁴ One way in which power is expressed is the progressive elimination of alternatives to problems as telecommunications structures become uniform. This theme of exclusion as a form of power is central to many analyses of globalisation.

29 Email to author from M. K. Sterpka, anthropologist of social movements and networks, currently Director of Family Services, Turner's Falls, MA, 21 November 2018.

30 Peter M. Haas, 'Introduction: Epistemic Communities and International Policy Coordination', *International Organization* 46, no. 1 (1992): 1–35, doi.org/10.1017/S0020818300001442.

31 Peter M. Haas, 'Do Regimes Matter? Epistemic Communities and Mediterranean Pollution Control', *International Organization* 43, no. 3 (1989): 377–403, doi.org/10.1017/S0020818300032975; Haas, 'Introduction'; Mai'a K. Davis Cross, 'Rethinking Epistemic Communities Twenty Years Later', *Review of International Studies* 39 (2013): 137–60, doi.org/10.1017/S0260210512000034.

32 Cross, 'Rethinking'.

33 Manuel Castells, 'A Network Theory of Power', *International Journal of Communications* 5 (2011): 773–87; Manuel Castells, *The Rise of the Network Society: The Information Age: Economy, Society and Culture*, vol. 1 (Malden, MA: Blackwell, 1996).

34 D. S. Grewal, *Network Power: The Social Dynamics of Globalization* (New Haven, CT: Yale University Press, 2008).

Michael Hardt and Antonio Negri identified the emerging globalised economic order as an empire—distinct from the imperialisms of the modern colonial era.³⁵ This system of organisation has no territorial boundaries and no centre. Rather, it is composed of networks of global elites and corporations in which values, ideas and authority are embedded. The controlling agencies of modern nation states are replaced by more internalised enforcement exercised through networks. Information and communications function as the primary mechanisms of control. Such post-industrial economies have been designated ‘informational economies’, and their societies ‘informational societies’.³⁶ Independently constructed networks with shared values that permeate and extend beyond the territories of modern nation states constitute the globalised economy of empire. Exclusion and inclusion are potent tools for ensuring compliance. Their codified application is expressed as a ‘rules-based system’.

The creation of databases and documents used in support of the biofuels discussion reflects these developments. The 1980s marked a change in international priorities resulting in the termination of extensive fieldwork (including ground truthing/validation). The coincidental rise of computing capabilities stimulated advances in mathematical simplification and modelling. This enabled a completely synthetic globalised view of the biogeophysical world supported by machine-generated data and new vocabularies.³⁷ Erik Reinert³⁸ contrasted database construction by abstraction—in which linkages to original observations are traceable—with increasing levels of simplification—in which numbers are stripped of all context. In its extreme form, simplification produces data that achieve a state of ‘practical irrelevance’.³⁹ As new, synthetic landscapes were constructed, exclusion was practised systematically.⁴⁰ Databases consisting of numbers with untraceable origins were used in models to evaluate soils and landscapes at the simplified level of grid cells. Access to database construction and use was limited by technology, vocabulary and institutional affiliation. These processes existed in a larger context of shifting bases of power.

35 Michael Hardt and Antonio Negri, *Empire* (Cambridge, MA: Harvard University Press, 2000), 11.

36 Hardt and Negri, *Empire*, 285.

37 Showers, ‘Biofuels’ Unbalanced Equations. Part 1’.

38 Erik S. Reinert, ‘The Terrible Simplifiers: Common Origins of Financial Crises and Persistent Poverty in Economic Theory and the New “1948” Movement’, in *Poor Poverty: The Impoverishment of Analysis, Measurement and Policies*, ed. K. S. Jomo and Anis Chowdhury (London and New York: Bloomsbury Academic in association with the United Nations, 2011).

39 Reinert, ‘The Terrible Simplifiers’, 13.

40 Discussed in detail in Showers, ‘Biofuels’ Unbalanced Equations. Part 1’.

Hardt and Negri identified the UN as a 'hinge' institution between modern ideas of sovereignty based on nation states bound by treaties and pacts, and globalised notions of rights held at a supranational centre.⁴¹ The UN agencies' contributions to the databases, models and documents central to biofuels advocacy reflect the transition from collecting and manipulating data at the national level for national policy priorities to constructing data sets and databases in response to globalised agendas. Within the institutions historically mandated to support agricultural production, the reassignment of staff from practically focused and field-based activities to mathematical manipulations and formulating problems at unbounded global scales reflects the arrival of the interests of informational societies. The proliferation of databases and model creation suggests the internalisation of controlling mechanisms. Significant deviation is not possible when a model has embedded within it basic parameters that define biophysical attributes or a particular problem. Alternative interpretations are reduced, if not eliminated, when observed information is removed from the social, cultural and ecological contexts that gave it meaning,⁴² or is replaced entirely by manufactured data. This has practical significance and historical precedents. Environmental historians have documented the failure of technical advice and programs in the twentieth century due to the inability of professionals, acknowledged experts and authorities to appreciate the importance of specific variation and local environmental knowledge.

Leslie Sklair's analysis of power within the emerging globalised system explores the role of corporations and their transformation from national to supranational institutions.⁴³ A transnational capitalist class (TCC) composed of a small group of global elites shares a transnational world view. With claims of a base in neutral science and neutral policy, this perspective is presented as the only legitimate source of knowledge. Globalising politicians, bureaucrats and professionals link corporate interests with previously independent institutions through participation in joint commissions, as well as by board and committee membership. The corporate fraction exerts its power through funding and lobbying. Sklair describes the ways in which the TCC has ensured that both the environment and sustainable development are framed by the world view of economists. Tracing the influence of corporate interests in biofuels analyses is far beyond the scope of this paper. Corporate involvement has been suggested in the preceding discussion of energy modelling and database construction and hosting. A casual survey of contributors to the boards of agencies and editorial consulting groups listed in biofuels reports demonstrates strong representation from the transportation and fossil-fuel energy sectors.

41 Hardt and Negri, *Empire*.

42 Bowers, *Let Them Eat Data*, 71.

43 L. Sklair, 'Democracy and the Transnational Capitalist Class', *Annals of the American Academy of Political and Social Science* 581, no. 1 (May 2002): 144–157, doi.org/10.1177/000271620258100113.

Networked consensus

As projects are conceived and developed, and years become decades, collaborators reach agreement about the purpose, direction and limits of their activities, as well as about specific areas of concern. Without this, collaboration would be difficult, if not impossible. However, the enabling role of various sources of bias is not usually considered. Shared values, beliefs and academic principles bring individuals to fundamental agreement so that details of project implementation are discussed under unacknowledged, culturally bounded conditions. Each time a choice is made, a modeller's world view will be consciously or unconsciously expressed. Model construction thus embeds institutional and professional consensus, which may, or may not, moderate an individual modeller's personal biases. No matter how mathematically complex, databases and models are neither value-free nor objective. Their applications and use are exercises in social power. This operation of bias in decision-making processes is largely unconscious.

If an area of work is to be extended, retention of core researchers is logical. Collaboration in subsequent projects is easier when continuity of professional consensus can be maintained, including underlying assumptions, approaches, best frameworks and methodologies. Specialised vocabularies and conventions evolve, and project perspectives develop. Considering their formal and informal discussions to be expert consultations, no further justification is required. For example, a meeting between officials from the FAO and UNEP in Rome was described as 'an expert consultation on soil degradation'.⁴⁴ Discussion amongst officials from ISRIC and UNEP that ended in making recommendations was characterised as an 'ad hoc expert meeting'.⁴⁵ When revising the Agro-ecological Zones methodology, modellers needed a refinement of the 'agro-edaphic element'. A new database, constructed from existing soil and water information combined with derived statistics, was 'revised by a group of soil experts'.⁴⁶ Various approaches were taken to ground-truth and verify the results of GAEZ analysis: 'Apart from consulting expert knowledge and agricultural research institutes, results have been systematically compared with research data and agricultural statistics'.⁴⁷ Continual reference to unidentified experts and their opinions is one way in which professionally constructed biases become embedded and remain unchallenged.

44 L. R. Oldeman, R. T. A. Hakkeling and W. G. Sombroek, *World Map of Human-Induced Soil Degradation. An Explanatory Note*, 2nd ed. (Wageningen: ISRIC; Nairobi: UNEP, 1991), 1.

45 Oldeman et al., *World Map*, 2.

46 N. H. Batjes, G. Fischer, V. Stobolvoi, F. O. Nachtergaele and H. van Velthuizen, *Soil Data Derived from WISE for use in Global and Regional AEZ Studies* (Version 1.0), 1997, pure.iiasa.ac.at/id/eprint/5266, accessed 13 December 2018.

47 FAO, 'What are the GAEZ limitations', GAEZ—Global Agro-ecological Zones. Frequently Asked Questions, www.fao.org/nt/gaez/faqs/en, accessed 23 January 2016.

The row labelled 'Profession' in Table 1 lists the area of specialisation of the primary contributors to each of the projects. It provides a broad indication of the academic perspectives brought to each collaboration. These intellectual boundaries influenced, if not determined, the creation of tools for data expansion. The methods employed were based upon mathematical formulae as well as the 'rules' for categorising soil information that arose when fieldwork was replaced by data mining, derivations and modelling.⁴⁸ Soil scientists used collective professional opinion to assess soil properties and to include or exclude soil bodies. They valued landscapes in terms of agreed-upon definitions of productivity and potential. Further manipulation expanded or created entirely new data sets. With quantification and then presentation as databases and maps, the existence of underlying decisions and subjectivity became invisible. The bias arising from choices required in data collection, manipulation and analysis was further obscured through anonymous institutional publication on websites and in print. The lack of personal attribution created institutional authority. It also masked the small number of authors—and eliminated personal responsibility.

Homogeneity

Ecological theory asserts that diversity is a major component of resilience, endowing ecosystems with flexibility in the face of unusual events. It can be argued that the same logic applies to database and model construction. Part 1 of this series of articles examined the deliberate application of mathematics to reduce diversity in data sets and databases resulting in the systematic loss of detail that the term 'homogenisation' implies. This narrowing of information is concealed by digital presentation formats, from graphs to maps. Previous paragraphs have traced the ways in which personal and professional biases inform professional consensus. The potential for cumulative weakness is demonstrated in the early twenty-first century's reliance on mid-twentieth-century energy demand models.

Projections and estimates of energy demand reflected the logic encapsulated in the two model families and the single model described earlier. The chronology of energy model development demonstrated that the models were the product of the imagination of and consensus among a small group of largely European men at 10 institutions in seven European cities during the mid-twentieth century. Assumptions included rates of increased per-capita use of electricity (i.e. before the development of energy-intensive internet and associated technologies); consumption of transportation fossil fuels in areas where access already exists; and expansion in under- and unserved regions.

48 See Showers, 'Biofuels Unbalanced Equations. Part 1'.

The limited outlook encompassed in these models is consistent with that found in the international energy literature. Benjamin Sovacool's 2014 evaluation of 4,444 full-length review articles published between 1999 and 2013 in the journals *Energy Policy*, *The Energy Journal* and *The Electricity Journal* demonstrated the extreme narrowness of the dominant energy literature's scope.⁴⁹ Four trends were revealed: 1) an undervaluation of the influence of social dimensions on energy use; 2) a bias towards science, engineering and economics over social sciences and the humanities; 3) a lack of interdisciplinary collaboration; and 4) an under-representation of female and minority group authors. Most of the world was under-represented—85 per cent of the authors came from North American or European institutions.

The energy models were based on econometric and technological parameters. They varied only by data inputs and abilities to apply restrictions. Financial layers could be easily inserted into models addressing other topics. Economic growth was a dominant factor in assessments, and various expressions of cost minimisation were woven into theories and analyses. Activities, things, places and people were labelled as either economic or non-economic, and ranked according to constructed scales of relative importance. Non-economic entities labelled as externalities were ignored, including quality of human life, environmental integrity and public health. The problem with economically driven models is that if assumptions about what constitutes economic behaviour and its influences change, the model comes apart. This happened in 2008, as explicitly stated by Pierre Gadonneix, Chairman of the WEC:

The great economic crisis in 2008 took the whole world by surprise and it took us more than two years to fully understand the magnitude of the shock and draw on the full lessons of its consequences for the energy sector. The current development of new unconventional fossil fuel resources in the world, especially in the United States, also boomed almost unexpectedly, creating new opportunities ... world leaders now do not want prognostics and descriptions of the future that are likely to be proven false. Rather, they critically need long-term scenarios, apt at showing a diversity of possible trajectories, and at identifying 'weak signals' that could become game changers, at considering regional ruptures, and imagining how they could impact on the global scene. World leaders need to be prepared for a more diverse set of possible futures in order to make their own choices.⁵⁰

In the second decade of the twenty-first century, agencies switched from confident predictions to scenarios. Scenarios provide possible alternative outcomes if assumptions change. Scenario modelling must consider 'black swans' (theoretically

49 Benjamin K. Sovacool, 'Diversity: Energy Studies Need Social Science', *Nature* 511 (31 July 2014): 529–30, doi.org/10.1038/511529a.

50 Pierre Gadonneix, preface to Danièle Revel, *World Energy Scenarios: Composing Energy Futures to 2050* (London: World Energy Council, 2013): 6.

impossible events) or 'wild cards' (a factor that is highly unpredictable but possibly of high impact) that can 'change the scenario landscape significantly, including once-in-a-lifetime events like Fuk[u]shima' (the nuclear plant explosion in 2011).⁵¹

Constructing scenarios is an intellectual exercise based upon words and ideas. Quantification is required to transform them from stories to models for analysis and projections. This is achieved by deconstructing scenario components into discrete constituent parts to create quantified 'inputs'. The result can be disaggregation of obviously interacting constituents and interdependent systems. Assumptions guide which parts of a scenario should be included and quantified, as well as how they interact. The resulting scenario models will have embedded in them the beliefs and values of the quantifier(s) and a considerable amount of social power.

WEC used the GMM-MARKAL model to quantify their scenario storylines because it allows the world to be split into regions for analysis.⁵² The model's assumptions were not stated. During the two decades of energy demand model construction, the dominant world view was neo-liberal economics. This is precisely the vision that was surprised and profoundly disoriented by the global financial crisis in 2008.

Embedded inaccuracy

Advances in computing capability and capacity and the expansion of information technology coincided with the rise of the neo-liberal economic agenda. The focus of international policy shifted from the worldwide national scale to the coarser-grained global scale. Local and national levels of measurement were increasingly displaced by mathematically derived globalised statistics expressed in units of grid cells.⁵³ The 'Methods' row of Table 1 indicates the extent to which subjectivity is a structural component of the eight scientific data sources. Expert opinion, estimation, derivations and harmonisation are all the result of a sequence of decisions about what to exclude or include and what and how to value and rank different characteristics. When quantified, these subjective decisions become data assumed to be without bias.

Building—and building upon—consensus, institutions exchanged data and cited each other's publications. Despite caveats about data quality, data sets, data layers and databases moved from one application to another. Often they were applied in contexts completely unrelated to the original purpose of data collection. This violates fundamental rules of statistical inference. Models and model results have frequently been included uncritically in the structure of analytical tools operating at coarser scales because the authority of the original publishing institution implied

51 WEC, *World Energy Scenarios*.

52 *ibid.*, 38.

53 See Showers, 'Biofuels' Unbalanced Equations. Part 1' for discussion.

highest data quality. Yet, with each inclusion in a larger database or model, not only biases and assumptions, but also data weaknesses and limitations become embedded—and less apparent. This contributes to, and perhaps exacerbates, the inherent unreliability of globalised statistics. As Michael Goodchild noted in 1988, ‘at global scales, database validation, regardless of theme, has been viewed as an impossible task’.⁵⁴

These patterns are illustrated in the construction of the widely used Global Land Cover Characteristics Database (GLCCD) described below. To clarify interactions and problems, the database will be discussed from its inception.

Global Land Cover Characteristics Database

Discussants at a 1992 International Geosphere–Biosphere (IGBP) workshop in Toulouse concluded that the most important information missing from global data sets was land cover characterisation.⁵⁵ Subsequent collaboration between the United States Geological Survey’s (USGS) National Center for Earth Resources Observation and Science (EROS), the University of Nebraska–Lincoln (United States), and the Joint Research Centre (JRC) of the European Commission generated a Global Land Cover Characteristics Database (GLCCD v. 1.0), released in 1997.⁵⁶ According to its documentation, the GLCCD was developed on a continent-by-continent basis using the same map projection (1-km nominal spatial resolution) and derived from 1-km Advanced Very High Resolution Radiometer (AVHRR) data covering the 12-month period from April 1992 to March 1993. Its construction was based on a flexible database structure and a seasonal land cover regions concept. The GLCCD included an aggregation of seven derived land cover data sets. However, because of the constraints of cost, time and logistics, only one (IGBP DISCover) ‘will be validated to determine overall global accuracy’.⁵⁷

Rather than using defined mapping units, the land cover regions are a simplification summarising ‘descriptive and authoritative attributes’.⁵⁸ The database builders intended that these attributes would be thought of as:

54 M. F. Goodchild, ‘The Issue of Accuracy’, in *Building Databases for Global Science*, ed. Helen Mounsey and Roger F Tomlinson (New York: Taylor and Francis, 1988), quoted in T. R. Loveland et al., ‘Development of a Global Land Cover Characteristics Database and IGBP DISCover from 1 km AVHRR Data’, *International Journal of Remote Sensing* 21, no. 6–7 (2000): 1324.

55 Loveland et al., ‘Development of a Global Landcover’, 1304.

56 United States Geological Survey (USGS), *Global Land Cover Characteristics Data Base* Version 2.0, 2012, edcftp.cr.usgs.gov/project/glcc/globdoc2_0.html, accessed 29 October 2019.

57 Loveland et al., ‘Development of a Global Landcover’, 1309.

58 USGS, *Global Land Cover*, 1.1.

spreadsheets of region characteristics and permit updating, calculating and transforming the entries into new parameters or classes. This provides flexibility for using the land cover characteristics data base in a variety of models without extensive modification of model outputs.⁵⁹

The GLCCD contains derived databases—not data sets from measurement or observation—including:

- Global Ecosystems;
- IGBP Land Cover Classification;
- USGS Land Use/Land Cover System;
- Simple biosphere model;
- Biosphere Atmosphere Transfer Scheme;
- Vegetation Life Form.⁶⁰

When published, it was hosted at the EROS data centre. After responses by users, revisions were made and a new version (GLCCD v. 2.0) was released in 2012. However, as the website documentation emphasises, v. 2.0 still uses the 1992/93 AVHRR time series as a basic data set.⁶¹ In discussing v. 1.0, Thomas Loveland et al. warned:

caution concerning the global and continental land cover composition estimates is necessary. These figures are the results of the land cover classification process but the area estimates have not been validated and do not have error terms associated with them at this time; furthermore, there are no plans to perform any validation of these continental estimates. Interpretation error is certainly present.⁶²

Therefore, all models and databases using either v. 1.0 or 2.0 of the GLCCD will reflect estimates based upon interpretations of satellite imagery between April 1992 and March 1993. They have not been, and will not be, validated. Neither GLCCD v. 1.0 nor 2.0 reflect actual turn-of-the-century land-use change. However, the use of the 1992–93 remote-sensing data as a base, and the numerous warnings about the incorporated derived data's lack of validation failed to deter the application of GLCCD in further modelling work, including GAEZ, in the early twenty-first century.

The International Food Policy Research Institute (IFPRI) published an Agricultural Extent Database in 2002. In collaboration with IIASA, IFPRI modellers 'reinterpreted' v. 1.0 of the GLCCD to create a 'global land cover categorization by harmonizing most of the existing land cover data. A crowd source platform is also designed to improve the quality of the data'.⁶³

⁵⁹ *ibid.*

⁶⁰ *ibid.*, 5.0.

⁶¹ *ibid.*, 4.0.

⁶² Loveland et al., 'Development of a Global Landcover', 1321.

⁶³ Zhe Guo via Michael Go, IFPRI, email message to author, 6 April 2016.

This further simplification was described as a ‘global land cover categorization providing 17 land cover classes at 30 arc-seconds’.⁶⁴ It was promoted as a new and improved data source.

The GLCCD v. 2.0 is a fundamental component of IIASA/FAO’s GAEZ v. 3.0. One of the new databases in this version is the IFPRI Agricultural Extent Database. Despite promotion as a land-use planning tool, and widespread application by researchers, GAEZ’s v. 3.0’s land cover base information remains tied to the unvalidated remotely sensed data from 1992/93. Biofuels analysts and researchers should find this 12-month period significant. The satellite passes will not have registered the dramatic land use changes that resulted from restructured economies or the forest and savannah losses due to the sharp increase in biofuels production between 1994 and 2012, or rampant illegal logging. All estimates of land availability will, therefore, certainly be exaggerations. Furthermore, the GAEZ documentation states that GAEZ data are not comparable with those of FAOSTAT because GAEZ data are estimates based upon an analysis of pixels rather than any kind of measurement.⁶⁵ The extent of simplification built into GAEZ means that the gap between biogeophysical reality and its modelled world is substantial.

Structural self-referencing

If quantification facilitates the removal of data from its original context, then modelling ensures and disguises erasure. Modelling could, therefore, meet Reinert’s⁶⁶ definition of simplification and, perhaps, practical irrelevance. This is particularly evident in the use of multilateral global land and terrain databases. Measurement-based data sets held by various agencies were used to derive new data sets and construct new databases, referred to as ‘products’.⁶⁷ One of the collaborating institutions—or a separate entity (public or private sector)—would take responsibility for hosting and maintaining these extremely large collections. Given the scope of effort and resources required to produce and store them, alternatives did not easily emerge. In this way, each database became the standard reference for its area of concern.

Hosting institutions made the databases easily available. The data sets and databases could be combined with others or used as layers in models to construct analytical tools suited to diverse concerns. The result was the generation of apparently new sources of information. The assumptions and estimates, as well as temporal and spatial limitations, of individual data sets or layers within the original database

64 IIASA / Food and Agriculture Organization, *Global Agro-ecological Zones (GAEZ v3.0)* (Laxenburg: IIASA; Rome: FAO, 2012): 11.

65 IIASA/FAO, *Global Agro-ecological Zones*.

66 Reinert, ‘The Terrible Simplifiers’.

67 See Showers, ‘Biofuels’ Unbalanced Equations. Part 1’ for details.

were largely overlooked in application. They become invisible when incorporated into models designed for ease of use by non-specialists in practical exercises such as policy analysis. The GLCCD's proliferation demonstrates a general acceptance—or ignorance—of the limitations of coarse-scale databases. The extent to which a single data layer defines much of the modelling and analytical work related to analyses of biofuels production should be of greater concern.

Circular citations

The eight sources of information listed in Table 1 have been considered to be authoritative because of their institutional origins. They have been used unquestioningly to frame discussions, support analyses and guide policies. The presence of an underlying networked consensus or embedded biases and inaccuracies caused by self-referencing is not readily apparent. Examination of authorship and acknowledgements hints at their existence. For example, although economists working in the Economics Division, Alexandratos and Bruinsma drew upon FAO departments for data and expertise to support their analysis in the *World Agriculture, Towards...* series, including Nachtergaele's Land and Water Development Division, which produced *Land Resource Potential and Constraints*, the TERRASTAT database and the AEZ methodology and family of models. The *Land Resource Potential and Constraints* report incorporated in its database estimates provided for Alexandratos' 1995 *World Agriculture: Towards 2010*. The Digital Soil Map of the World was the source of soils data for AEZ, GAEZ, *Land Resource Potential and Constraints*, and the TERRASTAT database. AEZ and GAEZ were used in the twenty-first-century publications of the *World Agriculture: Towards ...* series.

Not surprisingly, FAO publications have been based upon the AEZ framework analysis since its formalisation in 1982. Many were written by, or had acknowledged contributions from, AEZ's architects—FAO's Nachtergaele and IIASA's Fischer and van Velthuisen. AEZ and GAEZ have also been central to the work of the UN Framework Convention on Climate Change (UNFCCC). The AEZ methodology was recommended for use in climate change assessments of agricultural production in the UNFCCC First Compendium of Decision Tools to Evaluate Strategies for Adaptation to Climate Change.⁶⁸ GAEZ was recommended as a modelling tool in the 2005 Final Report,⁶⁹ and on the UNFCCC's website page 'Compendium on Methods and Tools to Evaluate Impacts, Vulnerability'. When biofuels feedstocks

68 UN Framework Convention on Climate Change (UNFCCC), *First Compendium of Decision Tools to Evaluate Strategies for Adaptation to Climate Change* (Bonn: United Nations Framework Convention on Climate Change Secretariat, 1999).

69 UNFCCC, *Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change*. Final Draft Report. SC 10341 (Bonn: United Nations Framework Convention on Climate Change Secretariat, 2005).

emerged as new, non-edible crops, GAEZ was employed by many to search for non-agricultural land upon which they could be grown. GAEZ also underpinned analysis presented in the OECD/IEA's *World Energy Outlook* series.⁷⁰

The GAEZ model was constructed from data layers and databases whose embedded professional biases have not been acknowledged. Its application in analysis reinforces those values while excluding other possibilities. Most of the constituent data have been in some way manipulated—derived, harmonised—and lack validation. Using GAEZ, therefore, shifts analysis from biophysical reality to a mathematically constructed universe of grid cells and pixels. Rather than an objective assessment, GAEZ actually reflects an underlying personally subjective, yet technologically derived, consensus about the nature, extent and value of the earth's surface.

Summary and conclusions

The models used for energy prediction and the eight major soil, land and terrain databases and models used in biofuels analyses have, unsurprisingly, been shown to be the result of significant collaboration over decades. Permanent employees and consultants built professional networks that facilitated the exchange of ideas, elaboration of concepts and formulation of programs. Institutional consensus developed about the most important soil characteristics and constraints to crop production, as well as how to describe and map them. The late twentieth-century transition referred to as economic globalisation coincided with rapid increases in computing power and developments in information technology. Globalisation affected soil scientists and agencies responsible for collecting and serving as curators of worldwide agricultural information. Mathematically derived data were digitised and substituted for field measurement as simplification replaced abstraction in the creation of new global/globalised data and data sets. In violation of the basic rules of statistics, data were removed from their original contexts and inserted into unrelated databases and models for applications in new projects. The results were expressed in units of grid cells rather than land area.

The development and continued widespread incorporation of the GLCDD containing unverified 1992–93 satellite imagery typifies the kinds and levels of inaccuracy in globalised data; the way in which layers' limitations are obscured within a model; the power of institutional authority to obviate critical assessment of data sources; and the extent to which a single database can become a fundamental constituent of apparently unrelated larger databases, models and analyses.

70 See Showers, 'Biofuels' Unbalanced Equations: Misleading Statistics, Networked Knowledge and Measured Parameters: Part 3. Modelled Marginal and Spare Land Versus Observed Ecosystems', *International Review of Environmental History*, forthcoming.

Globalised data are mathematically sophisticated and apparently novel. Yet globalised data sets, databases and models are largely self-referencing. They reinforce and amplify the biases and world views of the professional networks that created them. Social power is expressed in networked societies through the ability to exclude. Since both database and model construction involve a series of decisions about what to include and what to exclude, modelling is inherently an exercise in social power. A relatively small group of largely European men thus has had the power to define—and value—the earth's surface. They implanted their world views in tools promoted as objective, reliable and sophisticated for scientific analysis and prediction. Unelected, they have risen to power through employment by multilateral institutions and by access to technologies. They enabled, consciously or unconsciously, the exclusion of other people and their perspectives—most particularly, those with site-specific information that could contradict the modelled universe.

Globalised data sets, databases and models have collectively defined the parameters of the biofuels debate, but they are far from objective. They have power derived from the authority of the institutions that produced and host them. Because they operate at a very coarse scale, these databases and models are almost completely devoid of connection to local or specific conditions. Yet the attributes of particular places and their inhabitants (human and non-human) will determine the success or failure of biofuels cultivation as well as the extent to which cultivation could cause environmental or sociocultural harm.

There are practical consequences for farmers and landscapes around the world, as well as for efforts to mitigate environmental crises. Biofuels production targets at an industrial scale are set for theorised crops in the complete absence of knowledge of soils and their ecosystems, or farmers and their farming systems. If implemented, both agroecological and socioeconomic systems could be weakened, if not destroyed. Theorised beneficial changes in incomes and carbon balances may not occur, and significantly negative and unforeseen chains of events could be set in motion. Changing the scale and recovering diversity could produce more than local benefit. The cumulative effects of a variety of locally defined biofuels projects could contribute to emissions reduction when viewed from a global perspective.

'THE WAY OF THE RAIN': TOWARDS A CONCEPTUAL FRAMEWORK FOR THE RETROSPECTIVE EXAMINATION OF HISTORICAL AMERICAN AND AUSTRALIAN 'RAIN FOLLOWS THE PLOW/PLOUGH' MESSAGES

SUSAN E. SWANBERG

School of Journalism
College of Social and Behavioral Sciences
University of Arizona

Abstract

History establishes that even before the advent of modern media, erroneous climate messages were disseminated to the public. A folk belief captured by the phrase 'rain follows the plow' (RFTP) is a prime example of such misinformation. This belief, popular in the late nineteenth century, maintained that cultivation of arid lands in the United States beyond the 100th meridian west would boost precipitation, creating a climate more favourable for farming. Encouraged by this narrative, homesteaders cultivated arid lands west of the meridian. Rain did not follow the plough and many farms in the Great Plains failed. RFTP was also invoked in South Australia in support of agricultural settlement north of Goyder's Line, a geographical boundary delineating the limits of reliable rainfall in the colony. This article revisits the origins of the doctrine and places RFTP messaging in its historical context by examining articles and poetry published in American and Australian settlement-era newspapers. The results of two newspaper database surveys reveal that a number of historical RFTP stories and an environmental poem with religious overtones appeared first in US newspapers and were later republished in newspapers throughout Australia. One of the surveys also reveals that, from 1876 to 1898, reports of parliamentary discussions or debates referencing the slogan were published in South Australia. The dissemination of inaccurate climate information in settlement-era America and Australia is discussed in relation to a proposed conceptual framework based upon contemporary theories of science communication that might provide a basis for the analysis of historical science messaging.

Keywords: climate, rain follows the plow/plough, 100th meridian, Great Plains, Goyder's Line, Charles Dana Wilber, Samuel Aughey, science communication, United States, South Australia

Introduction

Messages conveying erroneous scientific information have been disseminated to the public throughout history, often influencing public policy and human behaviour. A prime example of such misinformation is a folk belief captured by the phrase ‘rain follows the plow’ (RFTP).¹ This belief, popular in the late nineteenth century, maintained that cultivation of arid lands in the United States beyond the 100th meridian west would boost precipitation, creating a climate more favourable for farming. Encouraged by this narrative, homesteaders cultivated arid lands west of the meridian. Rain did not follow the plough and many farms in the Great Plains failed. The same belief was disseminated throughout settlement-era Australia and invoked in the colony of South Australia in support of agricultural settlement north of Goyder’s Line, a geographical boundary delineating the limits of reliable rainfall in the colony.

This article revisits the origins of the doctrine and places RFTP messaging in its historical context by examining articles and poetry published in US and Australian settlement-era newspapers. The results of a database survey reveal that a number of historical RFTP stories appeared first in US newspapers and were republished in newspapers throughout Australia. The survey also reveals that, from 1876 to 1898, reports of parliamentary discussions or debates referencing the slogan were published in South Australian newspapers. In addition, ‘The Way of the Rain’, an American poem celebrating the RFTP doctrine, was published in American newspapers then republished in Australian newspapers.

The dissemination of inaccurate climate information about rainfall in the nineteenth century (the RFTP belief) is discussed here in relation to a proposed conceptual framework based upon contemporary theories of science communication. This framework, which provides a basis for the analysis of historical science communications, is drawn from twentieth- and twenty-first-century science communication models, including those described by Dan Kahan, Gordon

1 ‘Plow’ is used when discussing the American experience, while the spelling ‘plough’ is used when discussing the Australian experience. Database searches will not be productive unless the proper spelling is used. Although the term ‘pseudoscience’ was used in the nineteenth century, this article does not define the folk belief RFTP as pseudoscientific. The term ‘pseudoscience’ invokes a complex philosophical debate about the boundaries among science, non-science, pseudoscience and other human activities. A thorough discussion of the Demarcation Problem is beyond the scope of this essay. Those interested in historical use of the term ‘pseudoscience’ or a discussion of the Demarcation Problem can consult the following references: George M. Sternberg, ‘Science and Pseudo-science in Medicine’, *Science* 5, no. 110 (1897): 199–206, doi.org/10.1126/science.5.110.199; Alex Wellerstein, ‘Heterodoxy and Its Discontents’, *Science* 338, no. 6104 (2012): 194–5, doi.org/10.1126/science.1227959; Massimo Pigliucci and Maarten Boudry, eds, *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem* (Chicago: University of Chicago Press, 2013), doi.org/10.7208/chicago/9780226051826.001.0001; David B. Resnik, ‘A Pragmatic Approach to the Demarcation Problem’, *Studies in History and Philosophy of Science Part A* 31, no. 2 (2000): 249–67, doi.org/10.1016/S0039-3681(00)00004-2; Thomas F. Gieryn, ‘Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Science’, *American Sociological Review* 48, no. 6 (1983): 781–95, doi.org/10.2307/2095325.

Pennycook and their research associates, and includes seven primary mechanisms that might explain how and why people adopted science misinformation in Great Plains and South Australian agricultural settlements. Also included in the framework is a consideration titled ‘reality check’ with which scholars can factor in conflicts between scientific misinformation and real-world events such as drought. The tools provided by this framework can be used to propose hypotheses and conduct analyses of historical science-related messages.²

Evidence derived from the data examined herein suggests that an array of factors likely influenced Great Plains and South Australian settlers’ reception of and reaction to nineteenth-century RFTP messaging, which in turn influenced their decisions to establish farms, ranches and sheep runs on lands with less than optimal rainfall for agriculture. Graphical representations of this messaging suggest that it might have taken the harsh reality of drought for the American public to fully accept the fact that rain did not follow the plough.

This essay surveys historical newspaper coverage of the RFTP doctrine and lays the groundwork for the application of the proposed framework to critically assess processes by which RFTP beliefs evolved and were disseminated, debated and adopted (see Table 1). Application of this framework to a wide range of historical science or environmentally related messaging is possible.

Literature review: Models of science communication

In ‘Why Do People Fall for Fake News?’, the researchers Gordon Pennycook and David Rand make note of recent theories that might illuminate ‘the human weakness for misinformation’.³ In years past, the ‘deficit model’ of science communication, suggesting that top-down methods of communicating science resulted in public ignorance and hostility, was a serious contender as an explanation for the poor public understanding of science.⁴ The deficit model was followed by the ‘dialog

2 In a similar manner, Mike Conway, Maria Elizabeth Grabe and Kevin Grieves, ‘Villains, Victims and the Virtuous in Bill O’Reilly’s “No-Spin Zone”’, *Journalism Studies* 8, no. 2 (2007): 197–223, doi.org/10.1080/14616700601148820, repurposed seven propaganda devices developed by the Institute for Propaganda Analysis to develop hypotheses about and conduct content analyses of O’Reilly’s ‘Talking Points Memo’ editorials; also see Brian Trench, ‘Towards an Analytical Framework of Science Communication Models’, in *Communicating Science in Social Contexts: New Models, New Practices*, ed. Donghong Cheng et al. (New York: Springer, 2008), 119–35, doi.org/10.1007/978-1-4020-8598-7_7.

3 Gordon Pennycook and David Rand, ‘Why Do People Fall for Fake News?’, *New York Times*, 19 January 2019.

4 For a description of the deficit model of science communication see Patrick Sturgis and Nick Allum, ‘Science in Society: Re-evaluating the Deficit Model of Public Attitudes’, *Public Understanding of Science* 13, no. 1 (2004): 55–74, doi.org/10.1177/0963662504042690; Dan M. Kahan, Kathleen H. Jamieson and Dietram A. Scheufele, eds, *The Oxford Handbook of the Science of Science Communication* (New York: Oxford University Press, 2017), 219, 269, 293, 297.

model' where citizens were encouraged to engage in two-way communication with disseminators of science.⁵ According to Pennycook and Rand, however, there are two current models that do a better job of explaining why people fall for misinformation or propaganda. Much simplified, the first model (the Kahan model) hypothesises that we are 'hijacked by our partisan beliefs' and the second model (Pennycook and Rand's model) hypothesises that, for various reasons, we fail to exercise critical thinking in our decision-making processes—in other words, the authors say 'we're mentally lazy'.⁶

Kahan, a Yale Law School professor, conducts empirical research on human decision-making, frequently focusing on decisions requiring valid scientific evidence.⁷ He calls 'the failure of valid scientific evidence to quiet disputes over policy-relevant facts' the *science communication problem*. Kahan rejects as inadequate what he calls four 'false starts'—four popular and plausible explanations for the failure of science communication to eliminate public disagreement over policy-relevant scientific facts.⁸

These 'false starts'—theories Kahan says can explain only a few, isolated instances of science communication failure—include the 'irrational public' explanation (a variation of the deficit model); the 'obscure and partisan scientists' explanation; the 'age of denial' explanation; and the 'manipulated public' explanation, which suggests that some failures of rational evidence-based scientific decision-making are the result of orchestrated campaigns of scientific misinformation.⁹

Kahan offers four alternative explanations for why he believes the public has difficulty accepting what he calls 'decision-relevant' science (DRS). First, there is more decision-relevant science than members of the public can possibly understand, so they must accept as known more DRS than they can verify for themselves. Second, the public must be able to reliably recognise DRS in order to use DRS in decision-making. Third, public conflict over how to identify DRS is a recognition problem, not a comprehension problem. Finally, the recognition problem arises as a result of the tendency for people to align philosophically with the values of those with whom they share a cultural commitment. As a result, people tend to use biased

5 For additional science communication models see Trench, 'Towards an Analytical Framework of Science Communication Models', 119–20.

6 Pennycook and Rand, 'Why Do People Fall for Fake News?'.

7 Dan M. Kahan, 'What is the "Science of Science Communication"?' *Journal of Science Communication* 14, no. 3 (2015): 1, doi.org/10.22323/2.14030404; Dan M. Kahan, 'Fixing the Communications Failure', *Nature* 463, no. 7279 (2010): 296–7, doi.org/10.1038/463296a; Dan M. Kahan, 'Why Are We Poles Apart on Climate Change?' *Nature* 488, no. 7411 (2012): 255, doi.org/10.1038/488255a; Dan M. Kahan, 'On the Sources of Ordinary Science Knowledge and Extraordinary Science Ignorance', in *The Oxford Handbook of the Science of Science Communication*, ed. Jamieson, Kahan and Scheufele, 35–41, doi.org/10.1093/oxfordhb/9780190497620.013.4.

8 Kahan does not define what he means by 'valid scientific evidence', which for purposes of this essay will be defined as scientific evidence that has been evaluated and accepted by one's scientific peers. See Kahan, 'On the Sources of Ordinary Science Knowledge and Extraordinary Science Ignorance', 36–41.

9 *ibid.*, 35–49.

decision-making processes (what Kahan calls 'identity-protective cognition'), thus placing more value on the beliefs of those with whom they have an affinity than on information vetted by experts.¹⁰

Pennycook and Rand's competing, but not necessarily incompatible, view suggests that failure to exercise critical faculties motivates some people to go with their gut rather than engaging in cognitive reflection during the decision-making process. In support of their view, Pennycook and Rand demonstrate experimentally a number of cognitive mechanisms they suggest explain people's tendencies to believe 'outlandish' information. One of these mechanisms is 'the illusory truth effect', the premise that prior exposure to a statement increases the likelihood participants will judge it to be accurate—in other words, that repetition increases the fluency with which a statement (whether true or false) is processed and accepted as true.¹¹

The works of Kahan, Pennycook, Rand and others are important steps forward in understanding the mechanisms involved in science-related decision-making. Their empirical work is impressive and illuminating. In addition to conducting empirical research, however, it is important to examine retrospectively those instances in history when the understanding or communication of scientific principles did not or could not facilitate effective decision-making in what were some of the most important science-related decisions of the era. Here a framework based on twentieth- and twenty-first-century models of science communication is proposed as a tool to examine historical instances of science miscommunication, including environmental and climate messaging in the nineteenth century.

Table 1: Factors considered in the analysis of historical scientific messages.*

<p>Factor 1: The public's capacity and/or willingness to comprehend and converge collectively on what constitutes valid (for the era) scientific evidence due to one or more of the following:</p> <ul style="list-style-type: none"> • willingness to accept more valid (for the era) scientific evidence as true than individuals can verify on their own • ability to recognise valid (for the era) scientific evidence • difficulty recognising valid (for the era) scientific evidence • ability and/or willingness to exclude external factors (such as politics) that obscure the science communication environment.
<p>Factor 2: Failure of scientists to explain valid scientific principles accurately or effectively due to one or more of the following:</p> <ul style="list-style-type: none"> • lack of expertise • failure of the scientific environment (lack of adequate scientific training, for example) • state of scientific knowledge • bias or partisanship on the part of scientists.
<p>Factor 3: Preference for or dominance of religious or other belief systems when deciding matters of science.</p>

¹⁰ *ibid.*

¹¹ Gordon Pennycook, Tyrone D. Cannon and David G. Rand, 'Prior Exposure Increases Perceived Accuracy of Fake News', *Journal of Experimental Psychology: General* 147, no. 12 (2018): 1865–80, doi.org/10.1037/xge0000465.

Factor 4: The 'Illusory truth effect', i.e. the impact of repetitious messages.
Factor 5: Resistance to the authority of valid (for the era) scientific evidence [a form of science denialism].
Factor 6: The action of witting or unwitting transmission of misinformation due to one or both of the following: <ul style="list-style-type: none"> • orchestrated misinformation • misinformation conveyed, but not as an orchestrated effort.
Factor 7: The impact of public engagement on the public understanding of scientific issues. <ul style="list-style-type: none"> • Facilitated by top-down dissemination of scientific knowledge by scientists (a version of the deficit model). • Facilitated by public engagement in or observation of two-way dialogue with scientists or other disseminators of scientific messages (a version of the two-way dialogue model).
Reality check: The impact of harsh realities – What did it take for a science policy or belief course correction to occur (if one did occur)?

*Factors 1–7 were derived in part from references cited in notes 4–11.

Arid lands beyond America's 100th meridian

In the nineteenth century, a belief about the climate arose among those in favour of settling lands west of the 100th meridian, a line of longitude crossing North America that separates the arid west from the more humid east.¹² This belief, encapsulated by the phrase 'rain follows the plow', maintained that cultivation of arid or semi-arid lands beyond the 100th meridian would increase the evaporation of moisture, boost precipitation and effect a permanent change in the climate.¹³

Encouraged by a purported increase in the region's variable rainfall, promotion of the RFTP doctrine by railroad and real estate developers, and assertions by putative experts that the climate on the Great Plains was changing, homesteaders settled

12 J. A. Williamson, Commissioner of the Department of the Interior, 'Letter of Transmittal', in John Wesley Powell, *Report on the Lands of the Arid Region of the United States with a More Detailed Account of the Lands of Utah With Maps*, 2nd ed. (Washington, DC: Government Printing Office, 1879), iv–v, doi.org/10.3133/70039240. Available at pubs.usgs.gov/unnumbered/70039240/report.pdf.

13 Samuel Aughey, *Sketches of the Physical Geography and Geology of Nebraska* (Omaha, NE: Daily Republican Book and Job Office, 1880), 41–52, doi.org/10.5962/bhl.title.18267; Charles Dana Wilber, *The Great Valleys and Prairies of Nebraska and the Northwest* (Omaha, NE: Daily Republican Print, 1881), 69–92; Henry Nash Smith, 'Rain Follows the Plow: The Notion of Increased Rainfall for the Great Plains, 1844–1880', *Huntington Library Quarterly* 10, no. 2 (1947): 169–93, doi.org/10.2307/3815643; Walter Kollmorgen and Johanna Kollmorgen, 'Landscape Meteorology in the Plains Area', *Annals of the Association of American Geographers* 63, no. 4 (1973): 434–6, doi.org/10.1111/j.1467-8306.1973.tb00939.x; Cary J. Mock's modern interpretation of nineteenth-century evidence does not support the belief that rainfall was increasing on the Great Plains. See Mock's 'Rainfall in the Garden of the United States Great Plains, 1870–1889', *Climate Change* 44, no. 1–2 (2000): 173–95, doi.org/10.1023/A:1005570827123. Also see Francis H. Snow, 'Letters to the Editor—Is the rainfall increasing on the Plains[?]', *Science* 11, no. 269 (1888): 158, doi.org/10.1126/science.ns-11.269.158; George E. Curtis, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 272 (1888): 194, doi.org/10.1126/science.ns-11.272.194; H. A. Hazen, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 274 (1888): 218, doi.org/10.1126/science.ns-11.274.218; H. Helm Clayton, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 275 (1888): 229, doi.org/10.1126/science.ns-11.275.229; Adolphus W. Greely, 'Letters to the Editor—Is the Rainfall Increasing on the Plains?', *Science* 11, no. 276 (1888): 240, doi.org/10.1126/science.ns-11.276.240-b.

and attempted to farm lands beyond the meridian. Unfortunately, drought ensued and many farms succumbed.¹⁴ ‘Rain follows the plough’ was similarly invoked in South Australia by supporters of agricultural settlement beyond Goyder’s Line, a boundary that delineated the 10-inch isohyet (a line that joins all regions within a geographical area that experience an average annual rainfall of 10 inches) and the limits of reliable rainfall in the northern regions of the colony.¹⁵

Many historians have suggested that the phrase ‘rain follows the plow’ (if not the belief itself) originated in the nineteenth century among proponents of westward expansion across the North American continent. Harnessing a blend of idealism, religiosity and a sense of national exceptionalism, these boosters encouraged settlement of the American West, including the arid or semi-arid Great Plains region. Promoters of westward expansion often had their own agendas, but the overarching national agenda was distilled into a two-word slogan that would galvanise this migration to and settlement of the West. It was the country’s ‘manifest destiny’, wrote the editor and columnist John L. O’Sullivan in 1845, ‘to overspread the continent allotted by Providence for the free development of our yearly multiplying millions’.¹⁶ Through the efforts of homesteaders, the entire continent would soon become a ‘garden in the grasslands’, asserted RFTP believers.¹⁷

14 Peter Folger, *Drought in the United States: Causes and Current Understanding* (Washington, DC: Congressional Research Service, 2017), 2, 9. Available at fas.org/sgp/crs/misc/R43407.pdf; Gary D. Libecap and Zeynep Kocabişik Hansen, “Rain Follows the Plow” and Dryfarming Doctrine: The Climate Information Problem and Homestead Failure in the Upper Great Plains, 1890–1925’, *Journal of Economic History* 62, no. 1 (2002): 86–120.

15 Janis Sheldrick, *Nature’s Line: George Goyder Surveyor, Environmentalist, Visionary* (Mile End, SA: Wakefield Press, 2016), 272–5; Donald W. Meinig, *On the Margins of the Good Earth: The South Australian Wheat Frontier 1869–1884* (Chicago: Rand McNally & Company, 1962), 59–60; For an excellent comparison of Great Plains and South Australian settlement history and the role played by the ‘RFTP’ belief during colonisation of these two regions, see Kirsty Douglas’ essay, “For the Sake of a Little Grass”: A Comparative History of Settler Science and Environmental Limits in South Australia and the Great Plains’, in *Climate, Science, and Colonization*, ed. James Beattie, Emily O’Gorman and Matthew Henry (New York: Palgrave Macmillan, 2014), 99–117, doi.org/10.1057/9781137333933_6.

16 John O’Sullivan, ‘Annexation (1845)’, *United States Magazine and Democratic Review* 17, no. 1 (1845): 5–10; Adam Gomez, ‘Deus Vult: John L. O’Sullivan, Manifest Destiny, and American Democratic Messianism’, *American Political Thought* 1, no. 2 (2012): 236–62, doi.org/10.1086/667616.

17 David M. Emmons, *Garden in the Grasslands: Boomer Literature of the Central Great Plains* (Lincoln, NE: University of Nebraska Press, 1971), 1–24; Bradley H. Baltensperger, ‘Plains Promoters and Plain Folk: Pre-Migration and Post-Settlement Images of the Central Great Plains’ (PhD diss., Clark University, 1974), 7–8.

By the early to mid-nineteenth century it had become apparent that the lands west of the 100th meridian were quite unlike the humid lands of the eastern United States where settlers had farmed successfully for more than a century.¹⁸ The inconsistent rainfall in the Great Plains region presented a challenge. Early explorers had, in fact, originally labelled much of the land west of the Mississippi a 'Great American Desert'.¹⁹ Although this concept eventually fell into disrepute, much of the land beyond the 100th meridian was in fact arid or semi-arid.²⁰ If these lands were to be settled and exploited successfully, extraordinary efforts (such as large-scale land reclamation and water management projects) would be required.²¹

In 1862 and 1864, Congress passed two acts that provided federal land grant and loan subsidies to finance a transcontinental railroad.²² Pursuant to these acts, the financial burden of constructing a railroad would be offset by granting to railroad companies lands adjacent to the lines under development. This immediately increased the value of the ceded lands, which in turn prompted a rush to sell these lands to homesteaders. In 1862, Congress passed the Homestead Act, which endorsed conveying parcels of up to 160 acres to homesteaders.²³

In order to encourage homesteading of land once declared a desert, a new mythos was required, and 'rain follows the plow' fitted the bill. In one of the most effective public relations schemes ever undertaken, boosters of westward expansion maintained that farming was transforming the desert into a lush region with sufficient rain to grow all manner of crops.²⁴ The philosophy underpinning this phrase had ancient beginnings and dubious supporters.

18 Powell, *Report on the Lands of the Arid Region*, 23–4.

19 Zebulon Pike, 'Appendix to Part III', *Account of Expeditions to the Sources of the Mississippi, and through the Western Parts of Louisiana* (Philadelphia, PA: C. & A. Conrad, 1810), 5; Richard H. Dillon, 'Stephen Long's Great American Desert', *Proceedings of the American Philosophical Society* 111, no. 2 (1967): 93; Bradley H. Baltensperger, 'Plains Boomers and the Creation of the Great American Desert Myth', *Journal of Historical Geography* 18, no.1 (1992): 59–73, doi.org/10.1016/0305-7488(92)90276-F.

20 Charles R. Kutzler, 'Rain Follows the Plow: The History of an Idea' (PhD diss., University of Colorado, 1968), 166–251; Andrew Menard, 'Striking a Line through the Great American Desert', *Journal of American Studies* 45, no. 2 (2011): 267–80, doi.org/10.1017/S0021875810000034; Powell, *Report on the Lands of the Arid Region*, 23–4.

21 Powell, *Report on the Lands of the Arid Region*, 23–4.

22 The Pacific Railroad Act of 1862, *An Act to Aid in the Construction of a Railroad and Telegraph Line from the Missouri River to the Pacific Ocean, and to Secure to the Government the Use of the Same for Postal, Military, and Other Purposes*, was passed on 1 July 1862 (12 Statutes at Large 489); The Pacific Railroad Act of 1864, passed on 2 July 1864, doubled the size of land grants and authorised railroads to sell bonds (13 Statutes at Large 356).

23 The 1862 Homestead Act (Public Law 37–64; 12 Statutes at Large 392) provided settlers the opportunity to obtain 160 acres of public land by paying a small filing fee and residing on the land for a minimum of five years. Another option was for settlers to reside on the land for six months and purchase the land from the government for \$1.25 per acre.

24 Emmons, *Garden in the Grasslands*, 1–24; Smith, 'Rain Follows the Plow', 175–6; Wilber, *Great Valleys*, 66–7, 69–78; Baltensperger, 'Plains Promoters and Plain Folk', 7–8; Baltensperger, 'Plains Boomers and the Creation of the Great American Desert Myth'.

Rain follows the plow/plough: Origins of the maxim

According to the scholar Kenneth Thompson, beliefs associating climate change with clearing and cultivating land arose as early as the third century BC, and continued to be advanced throughout history.²⁵ The twentieth-century American scholar Henry Nash Smith associated folk beliefs predating the phrase 'rain follows the plow' with the journal entries of Josiah Gregg, a merchant-explorer who travelled the Santa Fe Trail between 1831 and 1840.²⁶ In 1869, Cyrus Thomas, a member of the US Geologist F. V. Hayden's scientific team, drafted a preliminary field report on Colorado and New Mexico in which he also articulated the belief that a permanent increase in rainfall was connected to settlement of the American West.²⁷

One Great Plains sceptic was Major John Wesley Powell, a geologist in charge of the US Geographical and Geological Survey of the Rocky Mountains region. After extensive exploration and much thought, Powell transmitted a geographical and geological survey of the United States' arid region to the federal government.²⁸ Powell reported that some of the lands were good for pasturage only and others would require irrigation to be farmed. According to Powell, redemption of these arid lands was beyond the capability of poor individual farmers, therefore farming in the region would require extensive governmental engagement in reclamation and irrigation.²⁹ After recounting many of the suggested reasons for a purported increase in water in the arid regions of the American West (including laying of railroad tracks, construction of telegraph lines, cultivation of the soil and the interposition of divine providence), Powell wrote the following:

Of course such hypotheses obtain credence because of a lack of information relating the laws which govern aqueous precipitation ... But the operations of man on the surface of the earth are so trivial that the conditions which they produce are of minute effect, and in [the] presence of the grand effects of nature escape discernment. Thus the alleged causes for the increase of rainfall fail. The rain gauge records of the country have been made but for a brief period, and the stations have been widely scattered, so that no very definite conclusions can be drawn from them, but so far as they are of value they fail to show any increase. But if it be true that increase of the water supply

25 For an excellent discussion of the history of speculation about climate change, see Kenneth Thompson, 'The Question of Climatic Stability in America Before 1900', *Climatic Change* 3, no. 3 (1981): 227–41, doi.org/10.1007/BF00136669.

26 Smith, 'Rain Follows the Plow', 172, citing Josiah Gregg, *Commerce of the Prairies: Or the Journal of a Santa Fe Trader*, vol. 2 (New York: Henry G. Langley, 1844): 202–3.

27 Cyrus Thomas, 'Agriculture of Colorado', in F. V. Hayden, *Preliminary Field Report of the United States Geological Survey of Colorado and New Mexico Conducted Under the Authority of Hon. J. D. Cox, Secretary of the Interior by F. V. Hayden United States Geologist* (Washington, DC: Government Printing Office, 1869): 141. Available online at tinyurl.com/ya8fgas4.

28 Powell, *Report on the Lands of the Arid Region*.

29 *ibid.*

is due to increase in precipitation, as many have supposed, the fact is not cheering to the agriculturist of the Arid Region. The permanent changes of nature are secular; any great sudden change is ephemeral, and usually such changes go in cycles, and the opposite or compensating conditions may reasonably be anticipated.³⁰

The great nineteenth-century climate change debate

Science in mid to late nineteenth-century America was in a state of evolution.³¹ Early in the nineteenth century, a significant segment of American science involved acquiring the pelts of animals and birds as well as collecting stones, fossils, shells and plants.³² A gentleman educated as a theologian might become a ‘botanizer’, collect dried plants and herbs, conduct a few lectures, and call himself a professor. Honorary degrees were dispensed with alacrity and provided the itinerant or amateur scientist who was able to secure such a degree an aura of expertise.³³ Research science was not widely practised in the United States during this time, although the growth of professional organisations such as the American Association for the Advancement of Science did much to further interest in and recognition of scientific research as one of the roles of a ‘man of science’.³⁴ The 1859 publication of Darwin’s *The Origin of Species* prompted considerable debate and conflict about the relationship between science and religion, with some characterising the relationship as a ‘war’.³⁵

30 *ibid.*, 90–1.

31 Hamilton Cravens, ‘American Science Comes of Age: An Institutional Perspective, 1850–1930’, *American Studies* 17, no. 2 (1976): 49–70; Paul Lucier, ‘The Professional and the Scientist in Nineteenth-Century America’, *Isis* 100, no. 4 (2009): 699–732, doi.org/10.1086/652016; James Rodger Fleming, *Meteorology in America, 1800–1870* (Baltimore, MD: Johns Hopkins University Press, 1990), xix.

32 Matthew Laubacher, ‘Cultures of Collection in Late Nineteenth Century American Natural History’ (PhD diss., Arizona State University, 2011), available at repository.asu.edu/attachments/56624/content/Laubacher_asu_0010E_10662.pdf. For an excellent discussion of the role of collectors in relation to amateur and ‘professional’ scientists, see Steve Ruskin, ‘The Business of Natural History: Charles Aiken, Colorado Ornithology, and the Role of the Professional Collector’, *Historical Studies in the Natural Sciences* 45, no. 3 (2015): 357–96, doi.org/10.1525/hsns.2015.45.3.357; see also Elizabeth B. Keeney, ‘Introduction’, *The Botanizers: Amateur Scientists in Nineteenth-Century America* (Chapel Hill, NC, and London: University of North Carolina Press, 1992), 1–21.

33 C. S. M., ‘Abundant Honorary Degrees’, *Science* 17, no. 428 (1903): 432, doi.org/10.1126/science.17.428.432; ‘Comment and Criticism’, *Science* 4, no. 74 (1884), doi.org/10.1126/science.ns-4.74.1; Barbara Spector, ‘Honorary Degrees: Controversial for Centuries’, *The Scientist*, 24 June 1991, available at www.the-scientist.com/news/honorary-degrees-controversial-for-centuries-60529.

34 Cravens, ‘American Science Comes of Age’; Lucier, ‘The Professional and the Scientist’; Robert V. Bruce, *The Launching of Modern American Science 1846–1876* (Ithaca, NY: Cornell University Press, 1987), 7–28.

35 Andrew D. White, ‘The Warfare of Science’, *Friends’ Intelligencer* 33, no. 2 (1876): 17; Andrew D. White, *A History of the Warfare of Science with Theology in Christendom* (New York: D. Appleton, 1874); John William Draper, ‘History of the Conflict Between Religion and Science’, *The International Review* 2, no. 5 (1875): 711.

European science, on the other hand, was known for fostering the growth of experimental science.³⁶ Scientists such as Antoine Lavoisier, who declared that mass/matter could be neither created nor destroyed, possessed an understanding of chemistry that, had it been widely taught in the colleges and universities of America, might have made folk beliefs like RFTP less tenable.³⁷ All who called themselves ‘men of science’ would have done well to observe these words, written by Lavoisier in the preface to his famous treatise on chemistry:

We must trust to nothing but facts: These are presented to us by Nature, and cannot deceive. We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth but by the natural road of experiment and observation.³⁸

In 1888, a debate about the supposed increase in rainfall on the Great Plains took place in the pages of the journal *Science*—a scientific publication inaugurated in 1880 and, after several fits and starts, acquired in 1900 by the American Association for the Advancement of Science. The debate began when Henry Gannett published rainfall data from ‘twenty-six stations at which rainfall records have been kept for periods ranging from six to twenty-eight years’.³⁹ Several writers responded, some supporting Gannett’s position that rainfall was not increasing in the region, and others opposing his position. Some argued that there were too many errors in the collection and recording of the rainfall records for the data to be reliable.⁴⁰ In spite of Powell’s arid lands report, many nineteenth-century ‘men of science’ continued to debate the rainfall issue. More than a century after the debate in *Science*, Cary J. Mock, author of ‘Rainfall in the Garden of the United States Great Plains, 1870–1889’, wrote that after reviewing precipitation records for the Great Plains region between 1870 and 1889, he found no evidence of persistently greater precipitation in the entire study area as compared to the late twentieth century.⁴¹

Increase or no increase, Powell rather forcefully insisted, much to the chagrin of Great Plains boosters, that successful settlement and rehabilitation of much of the public lands beyond the 100th meridian would require parcels larger than 160 acres, irrigation of some parcels, and relegation of other parcels to pasturage.⁴² Under

36 Cravens, ‘American Science Comes of Age’; Lucier, ‘The Professional and the Scientist’; Bruce, *The Launching of Modern American Science*.

37 Antoine Lavoisier, *Traité élémentaire de chimie, présenté dans un ordre nouveau et d’après les découvertes modernes* (Paris: Cuchet, 1789), doi.org/10.5962/bhl.title.67783. Translated into English by R. Kerr as *Elements of Chemistry, in a New Systematic Order, Containing All the Modern Discoveries* (Edinburgh: William Creech, 1790), as cited in George B. Kauffman, ‘The Making of Modern Chemistry’, *Nature* 338, no. 6218 (1989): 700, doi.org/10.1038/338699a0. Of course, Lavoisier’s experiments were conducted in closed systems consisting of connected items of glassware, whereas rainfall occurred in an open system. Regardless, Lavoisier’s work should have given promoters of RFTP pause.

38 *ibid.*

39 Henry Gannett, ‘Is the Rainfall Increasing Upon the Plains?’, *Science* 10, no. 265 (1888): 99–100, doi.org/10.1126/science.ns-11.265.99.

40 See note 13 above for references related to this rainfall debate in the journal *Science*.

41 Cary J. Mock, ‘Rainfall in the Garden of the United States Great Plains’, 173–95.

42 Powell, *Report on the Lands of the Arid Region*, 25–9.

pressure from policy makers, manifest destiny proponents and RFTP advocates, however, the US Government ignored Powell's recommendations and opened land west of the 100th meridian to homesteaders.⁴³

The messengers

Among the individuals who pressured the federal government of the United States to release the arid lands of the Great Plains for homesteading were two friends, boosters and self-promoters—Charles Dana Wilber and Samuel Aughey. Neither man had much, if any, formal education in science, but they both held strong negative opinions about Powell's proposed restrictions on Great Plains homesteading—opinions they disseminated widely.

The historian Jeremy Vetter, in the introduction to his fine book *Field Life: Science in the American West During the Railroad Era*, cautions against assuming that nineteenth-century scholars of natural history were professionals in the manner of twentieth-century scientists.⁴⁴ Many in this era without formal training often called themselves scientists. However, in the case of the dubious promoters of 'rain follows the plow', once the superficial patina of scholarship is scratched, one finds exaggerated credentials, sloppy science and even fraud or chicanery.⁴⁵

Samuel Aughey was trained as a theologian, claimed to be a scientist, and had a number of honorary degrees appended to his name.⁴⁶ In his 1880 book *Sketches of the Physical Geography and Geology of Nebraska*, Aughey wrote that he had collected

43 *Report of the Public Lands Commission, Created by the Act of March 3, 1879, Relating to Public Lands in the Western Portion of the United States and to the Operation of Existing Public Lands in the Western Portion of the United States and to the Operation of Existing Land Laws* (Washington, DC: Government Printing Office, 1880), available at tinyurl.com/yaqjsc5n; Karl Hess, Jr, 'John Wesley Powell and the Unmaking of the West', *Environmental History* 2, no. 1 (1997): 17, doi.org/10.2307/3985559; Wallace Stegner, *Beyond the 100th Meridian: John Wesley Powell and the Second Opening of the West* (New York: Penguin, 1953), 231–45.

44 Jeremy Vetter, *Field Life: Science in the American West During the Railroad Era* (Pittsburgh, PA: University of Pittsburgh Press, 2016), 14, doi.org/10.2307/1j.ctt1gxxqcp.

45 Dan Plazak, *A Hole in the Ground with a Liar at the Top* (Salt Lake City, UT: University of Utah Press, 2006), 117–123. Also see notes 65–8 below.

46 Aughey was awarded an AB (course unknown) from Gettysburg College in 1856, and completed a theological course at the Lutheran Theological Seminary, Gettysburg, in 1858. See Abdel Ross Wentz, *History of the Gettysburg Theological Seminary of the General Synod of the Evangelical Lutheran Church in the United States and the United Lutheran Church in America, Gettysburg, Pennsylvania* (Gettysburg, PA: Directors Gettysburg Theological Seminary, 1927), 192. See also 'Proceedings of the Lutheran Synod', *The Perry County Democrat* (Bloomfield, PA), 10 June 1858; an honorary PhD degree was awarded to Aughey by Pennsylvania College in 1873. See E. S. Bridenbaugh, ed., *The Pennsylvania College Book 1832–1882* (Philadelphia, PA: Lutheran Publication Society, 1882), 52. Other sources, including Aughey's obituary, suggest that he might have been awarded multiple honorary PhD degrees and an honorary LLD. See 'Prof. Samuel Aughey Lived a Useful Life: Was a Noted Scientist, an Able Teacher and Earnest Student of Theology', *Pullman Herald* (Pullman, WA), 23 February 1912, which stated: 'On the occasion of a certain commencement season (1874), the degree of Ph.D. was conferred upon him simultaneously by the Pennsylvania College, Wittenberg College, and the University of Ohio. In 1878 Wittenberg College honored him with the degree of L.L.D.'. Also see Wentz, *History of the Gettysburg Theological Seminary*, 414–15.

scientific evidence of ‘increasing rainfall’ in Nebraska including an increase in the number of springs, the appearance of water in old creek beds and changing vegetation. Of this anecdotal ‘evidence’ he wrote the following: ‘[t]he proofs ... that the rainfall of Nebraska is steadily increasing, are manifold. If space permitted, many more [proofs] could be given’.⁴⁷ The reason for this purported increase in rainfall, he opined, was ‘the great increase in the absorptive power of the soil, wrought by cultivation, that has caused, and continues to cause an increasing rainfall in the State’ of Nebraska.⁴⁸ In spite of the fact that he taught chemistry (and an array of other sciences he was not trained to teach) at the University of Nebraska, Aughey failed to consider Lavoisier’s Conservation of Matter principle.⁴⁹ Aughey failed to ask: if rain is increasing on the Great Plains, where must rain be decreasing or water transforming into another physical state?

Aughey described an ‘experiment’ he had conducted in 1872 in support of his hypothesis that rain followed the plough. After a heavy rain, Aughey dug two six-by-six-inch squares of soil from the farm of a certain Mr Hawley. The first sample was taken from unbroken prairie and the second sample from cultivated land. Aughey dried and weighed the two samples and concluded from the difference that the soil of the cultivated field had absorbed more rain.⁵⁰

Many ascribe authorship of the phrase ‘rain follows the plow’ to Wilber, but the expression’s provenance may be lost in the annals of history. Whether the speculator, railroad promoter, purported journalist and would-be scientist authored the phrase or not, Wilber certainly popularised it. Wilber’s scientific background and credentials are obscure. He graduated from Williams College in 1856 (course of study not known).⁵¹ According to the Williams College general catalogue, Wilber was also awarded an MA (course of study also unknown) by the College and an honorary law degree (LLD) by the University of Nebraska in 1879 during his friend Aughey’s tenure at the school.⁵² Wilber was often referred to as ‘Prof. Wilber’ in

47 *ibid.*, 42.

48 *ibid.*, 44.

49 Lavoisier, *Traité élémentaire de chimie*, as cited in Kauffman, ‘The Making of Modern Chemistry’, 700.

50 Aughey, *Sketches*, 41–52.

51 The *General Catalogue of the Officers and Graduates of Williams College*, (Williamstown, MA: Williams College, 1910), 261, contains an entry listing Charles Dana Wilber as an 1856 graduate of Williams College. No particular course of study is mentioned. The catalogue is available online at archive.org/details/generalcatalogue00willuoft/page/n4.

52 The *General Catalogue of the Officers and Graduates of Williams College*, 86, also contains an entry for Charles Dana Wilber, indicating that he was awarded an MA and an LLD by the University of Nebraska in 1879. The University of Nebraska’s website, ‘Honorary Degrees Recipients—Alphabetical’, nebraska.edu/docs/awards/docs/HonoraryDegreesChrono.pdf, has an entry listing C. D. Wilber as the recipient of an honorary LLD degree in 1880. Aughey was appointed a faculty member at the University of Nebraska in 1871 (Robert N. Manley, *Centennial History of the University of Nebraska, I: Frontier University, 1869–1919*, (Lincoln, NE: University of Nebraska, 1969), 22–3), and resigned his position in 1883 (‘The Lincoln Mystery: The Innocence of Professor Aughey Partially Established and His Resignation Accepted’, *St Joseph Gazette-Herald* (St Joseph, MO), 10 November 1883).

the newspapers of his day.⁵³ Robert N. Manley, author of the first volume of the *Centennial History of the University of Nebraska*, referred to Wilber as ‘an itinerant scientist’.⁵⁴

Aughey and Wilber pushed back against Powell’s report in newspaper interviews, speeches, a published pamphlet, and their books.⁵⁵ On 1 March 1880, an article by special correspondent J. W. Robbins was published in the then prominent Chicago newspaper, *The Daily Inter Ocean*. The article recounted Robbins’ 26 February 1880 interview of Wilbur—an interview the reporter conducted in the Nebraska town Wilber platted and named after himself.⁵⁶ In the interview, Wilber invoked (for what appears to be the first time in American newsprint) the biblical-sounding slogan that would help inspire millions to risk life, limb and whatever fortune they might have to settle marginal lands west of the 100th meridian.⁵⁷

Much of the impetus behind Aughey and Wilber’s publicity campaign came from a letter sent to them by Robert W. Furnas, then president of the Nebraska State Horticultural Society, and Martin Dunham, then president of the State Agricultural Society of Nebraska, to ‘Profs. Samuel Aughey and C. D. Wilber’ urging them to respond to government proposals to shut down homesteading and designate as pasturage portions of the state of Nebraska west of the 100th meridian.⁵⁸

Headlined ‘The Desert Makers’, the Robbins article praised Wilber and Aughey for their intelligent and astute ‘research’ of the wonderful Nebraska soil and the state’s changing climate.⁵⁹ In a question-and-answer session with the correspondent, Wilber repudiated the existence of a Great American Desert, extolled the agricultural virtues of lands beyond the 100th meridian, and derided so-called government experts who he claimed falsely represented that the territory beyond the 100th meridian was ‘desert land’, ‘non-farming land’ and land ‘only fit for pastoral uses’.⁶⁰ These experts were the ‘desert makers’ of the headline, asserted Wilber, people who hung on to the obsolete concept of a Great American Desert. According to Wilber, the climatic challenges to farming Great Plains lands were ‘interposed by wiseacres, kid-gloved

53 ‘Western Mining Bureau’, *Fort Scott Daily Monitor* (Fort Scott, KS), 11 October 1871; ‘A Compliment to Kansas’, *Leavenworth Daily Commercial* (Leavenworth, KS), 12 April 1871; ‘State Board of Agriculture’, *The Nebraska State Journal* (Lincoln, NE), 30 January 1880.

54 Manley, *Centennial History of the University of Nebraska*, 43.

55 J. W. Robbins, ‘The Desert-Makers’, *Daily Inter-Ocean* (Chicago), 1 March 1880; Samuel Aughey and C. D. Wilber, *Agriculture Beyond the 100th Meridian, or a Review of the U.S. Public Lands Commission* (Lincoln, NE: Lincoln Journal Company, State Printers, 1880); Wilber, *Great Valleys*, 168–72; Aughey, *Sketches*, 41–52.

56 Robbins, ‘The Desert-Makers’.

57 *ibid.*

58 Wilber, *Great Valleys*, 41.

59 Robbins, ‘The Desert-Makers’.

60 *ibid.*

experts, and closet-philosophers'.⁶¹ The challenges of settling these lands were torn asunder, said Wilber, by the farmer with his plough 'leaving us to remember the experts only as charlatans or quacks'.⁶²

In his treatise *The Great Valleys and Prairies of Nebraska and the Northwest*, published the year after the *Inter Ocean* interview, Wilber repeated the phrase 'rain follows the plow':

Suppose now that a new army of frontier farmers ... could, acting in concert, turn over the prairie sod, and after deep plowing and receiving the rain and moisture, present a new surface of green, growing crops instead of the dry, hard-baked earth covered with sparse buffalo grass. No one can question or doubt the inevitable effect of this cool condensing surface upon the moisture in the atmosphere as it moves over by the Western winds. A reduction of temperature must at once occur, accompanied by the usual phenomena of showers. The chief agency in this transformation is agriculture. To be more concise. *Rain follows the plow*.⁶³

For years Wilber had toured the lecture circuit addressing topics as disparate as the coal fields of Illinois, agricultural chemistry, botany and fossils.⁶⁴ Later 'Prof. Wilber' acted as an 'advance man' for railroad companies.⁶⁵ Still later he became involved in mining as a mine inspector.⁶⁶ Aughey and Wilber were partners in crime, both figuratively and literally. The most startling of Aughey and Wilber's 'collaborations', which might more accurately be described as a 'corroboration', involved the scandal that led to Aughey's resignation from the University of Nebraska in 1883. According to newspaper reports, for several years prior to his departure from the university, Aughey had been negotiating promissory notes with forged endorsements at Nebraska banks. According to one newspaper article, among those whose signatures were forged were a railroad attorney and a 'brother professor'.⁶⁷

61 *ibid.*

62 *ibid.*

63 Wilber, *Great Valleys*, 68 (emphasis in original).

64 'The Coal Fields of Illinois', *The Pantagraph* (Bloomington, IN), 9 February 1859; 'Aurora Institute and Clark Seminary: Courses of Study', *Chicago Tribune*, 4 July 1859; 'The Illinois Natural History Society', *Chicago Tribune*, 28 June 1859; 'A Compliment to Kansas', *Leavenworth Daily Commercial* (Kansas), 12 April 1871; 'State News', *The Red Cloud Chief* (Nebraska), 14 April 1875.

65 'Death of an Eminent Geologist. Prof. C. D. Wilber of Aurora, Ill., Who Was a Classmate of President Garfield', *Chicago Tribune*, 22 December 1891; 'Wilber's Founder Namesake A Little-Known College Prof', *Sunday Journal and Star* (Lincoln, NE), 29 July 1956; 'Prof. Wilber, Inspector of Mineral Lands', *Chetopa Advance* (Kansas), 2 February 1870.

66 'Prof. Wilber, Inspector of Mineral Lands', *Chetopa Advance* (Kansas), 2 February 1870.

67 'A Mighty Fall: A Learned and Distinguished Professor—A Noted Scientist—Dishonors his Position, Disgraces the State, Sacrifices His Good Name, and Sinks the Nebraska State University in Deeper Shame', *Lincoln Journal Star* (Nebraska), 28 July 1883; 'A Professor's Crime', *Quad-City Times* (Omaha, NE), 30 July 1883; 'Charged with Forgery', *Chicago Tribune*, 30 July 1883; 'Considerable excitement was created at Lincoln, Neb., recently...', *The Fort Scott Weekly Tribune* (Kansas), 2 August 1883; 'Gone Wrong: More About the Downfall of the Nebraska Professor', *The Dayton Herald* (Ohio), 1 August 1883.

The University of Nebraska held a hearing on the matter, which is where Wilber entered the picture. Aughey's defence was that a man by the name of Vigenham was the procurer of the forged signatures and that Aughey knew nothing of the forgeries. When challenged as to the existence of Vigenham, Aughey introduced a letter from Wilber stating that he distinctly remembered having been introduced to Vigenham. While Aughey was eventually exonerated by the Board of Regents, newspaper accounts suggest that the evidence on which the exoneration was based was not necessarily convincing.⁶⁸ In spite of their spurious credentials and suspect activities, neither Wilber nor Aughey hesitated to portray himself as an expert in a variety of scientific endeavours. These two supposed men of science left an indelible mark on the Great Plains region. The theory they espoused regarding rainfall was disseminated as far away as Australia.

'Rain follows the plough': A brief description of the Australian experience

In *On the Margins of the Good Earth* (1962), Donald Meinig noted the complexity of South Australia's origins story, including the role of Edward Gibbon Wakefield early in its history.⁶⁹ Having himself barely avoided transportation to an Australian penal colony, Wakefield turned his attentions to developing principles that would provide a foundation for the orderly colonisation of South Australia, including the recommendation that settlers should be voluntary pioneers.⁷⁰ Wakefield became acquainted with the manner in which so-called 'waste' lands (public domain lands) of several European countries and the United States were sold, and testified as an expert witness on this topic before the Select Committee of the House of Commons on the Disposal of Lands in the British Colonies.⁷¹ Some but not all of Wakefield's concerns would be adopted in the form of land policy for the settlement of South Australia. Wakefield's policy required that all lands opened for settlement should be surveyed.

68 William J. Armstrong, 'The Case of Prof. Aughey', *Nebraska State Journal* (Lincoln, NE), 25 August 1883; 'At a Called Meeting of the Regents ...', *Nebraska State Journal* (Lincoln, NE), 10 November 1883; 'The Lincoln Mystery'.

69 Meinig left out the more salacious details concerning Wakefield's abduction of a wealthy child bride; see *The Trial in Full of Edw. Gibbon Wakefield, and Others for The Abduction of Miss Turner, by The Lancaster Assizes, March 23, 1827* (London, 1827).

70 Meinig, *On the Margins*, 9–10.

71 Robert J. Shultz, 'Edward Gibbon Wakefield and the Development of his Theory of 'Systematic Colonization' (MA diss., University of Nebraska at Omaha, 1965), 75–80, available at tinyurl.com/yals8v4l.

George Goyder, appointed South Australia’s Surveyor-General in 1861, would play an important role in South Australia’s RFTP saga.⁷² Janis Sheldrick’s definitive biography of Goyder describes his extensive field activities as a government surveyor.⁷³ As first assistant surveyor-general (an early rung in the ladder of his career), Goyder explored the Flinders Ranges and the area around Lake Blanche. Seeing that Lake Blanche was experiencing unusual flooding and believing that rainfall was regular and adequate in the northern regions of the South Australian colony, Goyder pronounced the level of the flooded lake a permanent condition, thus contributing to a land rush north. Goyder’s conclusions about Lake Blanche were incorrect. The flooding he had observed did not occur on a regular basis. According to Sheldrick, Goyder sincerely regretted his mistake, which he freely admitted, and for which he apologised.⁷⁴

Controversy over settlement in South Australia was continuous during much of Goyder’s time as a public servant, particularly during the years when he surveyed the northern lands (on horseback) in response to requests by squatters for financial drought relief.⁷⁵ Goyder returned from these inspections convinced that he could delineate, via changes in the nature of the vegetation he had observed, a line beyond which rainfall was too unreliable for the land to be farmed.⁷⁶ The government wanted an effective way to determine who deserved official drought relief, but Goyder used the opportunity to delineate a frontier beyond which he believed agriculture was too risky. This became known as Goyder’s Line or, more accurately, Goyder’s Line of Reliable Rainfall.⁷⁷

As prime agricultural land south of Goyder’s Line was sold, settlers wanting to take a chance on lands to the north of it clamoured for the government to disregard Goyder’s field studies and sell lands beyond the line.⁷⁸ Against Goyder’s recommendations, the government of South Australia relented and lands north of Goyder’s Line were surveyed and sold.⁷⁹ In 1880, the same year in which Samuel Aughey’s book *Sketches of the Physical Geography and Geology of Nebraska* featured a discussion of the supposed relationship between cultivation and an increase in rainfall, a period of drought began in South Australia and agriculture, particularly wheat farms, started to fail.⁸⁰

72 Meinig, *On the Margins*, 11; Sheldrick, *Nature’s Line*, 1–16.

73 Sheldrick, *Nature’s Line*, 70.

74 *ibid.*

75 Meinig, *On the Margins*, 45; Sheldrick, *Nature’s Line*, 141–61; ‘The Northern Squatters’, *South Australian Weekly Chronicle* (Adelaide, SA), 6 May 1865.

76 Meinig, *On the Margins*, 45–6; Sheldrick, *Nature’s Line*, 141–61.

77 *ibid.*; Sheldrick, *Nature’s Line*, 394.

78 Meinig, *On the Margins*, 51–6; Sheldrick, *Nature’s Line*, 249–66.

79 Meinig, *On the Margins*, 64–6.

80 *ibid.*, 78–92.

During the 1880s in particular, newspapers reported parliamentary debates that included brief but spirited discussions about the settlement of South Australia's northern lands, the reliability of rainfall to the north, the geographical limits of agricultural versus pastoral pursuits, and the truth or falsity of RFTP.⁸¹ In 1888, a major drought year in much of Australia, the Commission of Land Laws in the hard-hit colony of South Australia considered the issue of failed wheat farming beyond Goyder's Line. According to Sheldrick, the findings of the commission vindicated Goyder's position on the unreliability of rainfall beyond the line.⁸²

'Rain follows the plow/plough': Newspaper coverage in the United States and Australia

During the last quarter of the nineteenth century, American articles referencing the RFTP doctrine appeared in newspapers from Lewisburg, Pennsylvania, westward. A search for the phrase 'rain follows the plow' in the newspapers.com database originally identified 264 American newspaper articles published between 1877 and 2017.⁸³ Articles using the words 'rain follows the plow' in a context unrelated to the folk doctrine were eliminated and the range examined was narrowed to include only those articles published between 1877 (the last year of a seven-year drought in the United States) and 1949 (approximately 10 years after the end of the Dust Bowl). The remaining 143 articles were published in newspapers across the country—with a significant number of articles published in Kansas (54) and Nebraska (14). All 143 articles were examined for references to 'rain follows the plow' that expressed either a positive/hopeful or a negative/sceptical attitude toward the folk belief. Articles containing keywords or phrases that referenced the topic in terms other than the popular maxim were not used in this portion of the survey as it was Wilber's famous phrase that was the focus.

Duplicate stories or articles were not eliminated as the volume of coverage of the phrase was deemed more important for the purpose of this survey than the singularity of particular stories. Many stories were published multiple times, primarily in separate newspapers but occasionally in multiple issues of the same publication. Figure 1 illustrates the distribution of negative/sceptical and positive/hopeful 'rain follows the plow' messages in the United States in five-year intervals between 1870 and 1949.

81 'Proceedings in Parliament', *South Australian Advertiser* (Adelaide, SA), 30 June 1882; 'The Parliament, House of Assembly', *Adelaide Observer*, 9 June 1883; 'Parliamentary, Disposal of Public Lands', *Express and Telegraph* (Adelaide, SA), 2 July 1890.

82 Sheldrick, *Nature's Line*, 347–8.

83 'Newspapers.com is the largest online newspaper archive with 300+ million pages of historical newspapers from 11,100+ newspapers from around the United States and beyond.'

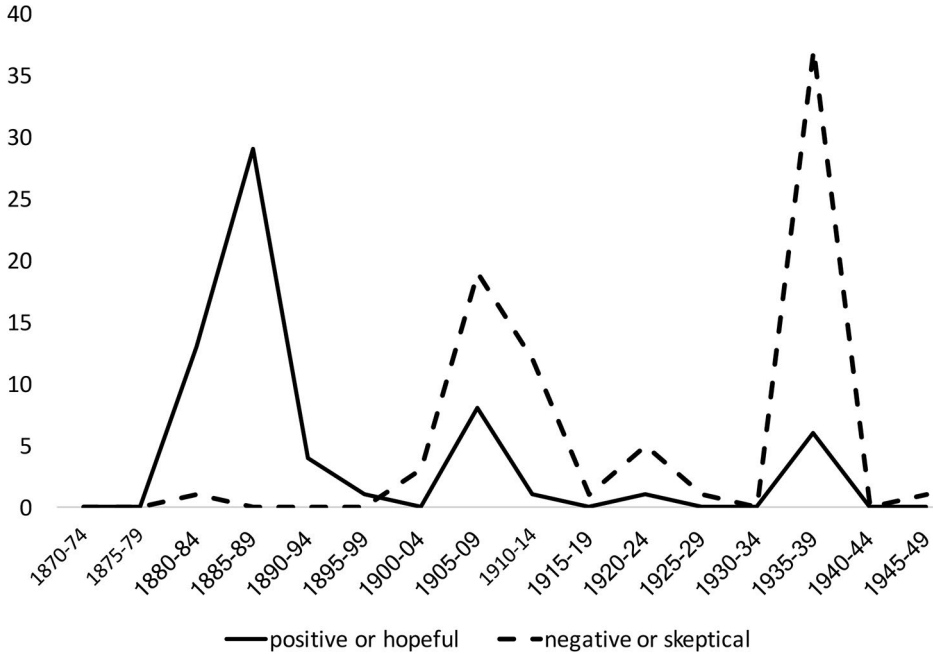


Figure 1: Positive and negative 'rain follows the plow' articles in US newspapers.
Source: The author.

An examination of Australian newspapers was conducted using the database Trove.⁸⁴ A keyword search for the phrase 'rain follows the plough' identified 250 articles published in Australian newspapers from 1870 through 1949. Seventeen false positive messages were eliminated and the remaining texts including the phrase 'rain follows the plough' were scored according to whether the phrase was used in a positive/hopeful context, a negative/sceptical context, or in the course of a news article covering a parliamentary debate or discussion (which often included both positive and negative references). A majority (190) of the remaining articles appeared in South Australian newspapers. Of those 190, 161 were Adelaide newspapers.

Figure 2 illustrates the distribution of these Australian RFTP messages in five-year intervals from 1870 through 1949. Table 2 lists relevant drought periods in the United States and Australia, and Figure 3 compares overall coverage of RFTP messaging (in five-year intervals from 1870 through 1949) in US and Australian newspapers.

⁸⁴ Trove is a database curated by the National Library of Australia and can be accessed at trove.nla.gov.au.

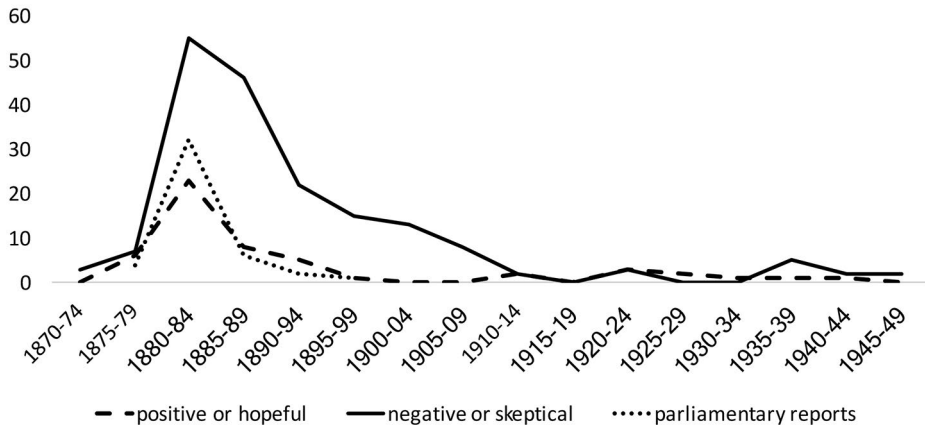


Figure 2: Positive and negative ‘rain follows the plough’ articles in Australian newspapers (and a subset of articles containing parliamentary reports).

Source: The author.

Table 2: Relevant US and Australian drought history.

American droughts ^a	Australian droughts ^b
1856–1865 ('Civil War drought')	1864–1866 & 1868
1870–1877	1880–1886
1890–1896	1888
1930–1936 (the Dust Bowl)	1895–1903
	1911–1916
	1918–1920
	1939–1945

^a Peter Folger (2017) *Drought in the United States: Causes and Current Understanding*

^b Yearbook Australia, 1988

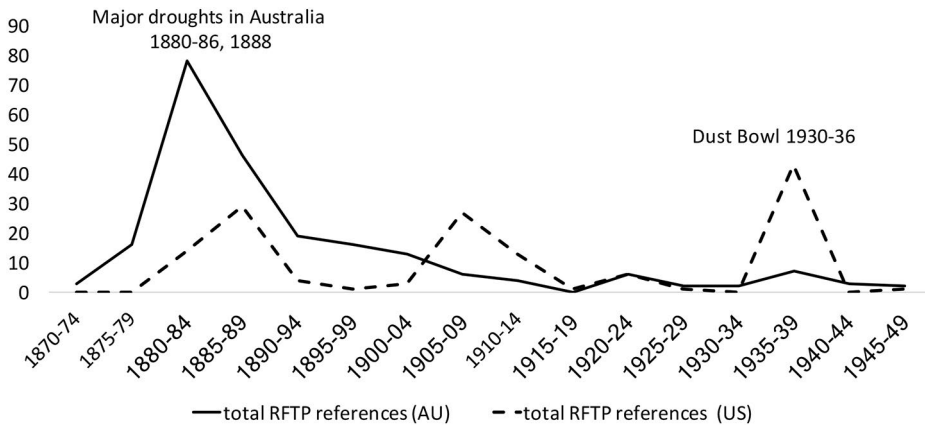


Figure 3: ‘Rain follows the plow/plough’ articles in US and Australian newspapers.

Source: The author.

Unexpectedly, a group of RFTP-related articles that used the phrase 'cultivation induces rainfall' rather than 'rain follows the plow/plough' were discovered in the American and Australian databases. These articles, first published in US newspapers or papers covering the Great Plains settlements then republished in whole or in part in several Australian newspapers, were identified during a search for Australian references to Aughey and Wilber. For example, on 24 December 1880, the *Saint John Weekly News*, a Kansas newspaper, published a review of Aughey's book *Sketches of the Physical Geography and Geology of Nebraska*, including an extensive discussion of Aughey's 'cultivation induces rainfall' theory.⁸⁵ On 6 July 1882, a substantial excerpt from the *Saint John Weekly News* review was reprinted in the New South Wales newspaper *The Shoalhaven Telegraph*.⁸⁶

On 24 October 1887, the Kansas newspaper the *Omaha Daily Bee* published a speech delivered by US General Henry A. Morrow at the Cheyenne County Fair held at Sidney, Nebraska.⁸⁷ Although Aughey was long gone from the University of Nebraska by that date and the general did not use Prof. Wilber's phrase 'rain follows the plow', Morrow's speech drew heavily on the concept behind the doctrine, including Aughey and Wilber's ideas about rainfall in the Great Plains. 'It is the history of every new country,' noted Morrow, 'that the rainfall increases in proportion as the land comes under cultivation. This is an undoubted fact, though the reasons assigned for it are not fully agreed upon by scientists.'⁸⁸

In 1888, a major drought year, newspapers throughout Australia reprinted the Kansas article recounting Morrow's speech. Similar excerpts from the speech, under the headline 'Why Cultivation Increases Rainfall', appeared in at least 16 Australian newspapers (at least one article published in every Australian colony) between 6 April and 7 July 1888. The article appeared again in Victoria's *Great Southern Advocate* on 5 January 1893 (see Table 3).

Table 3: Publication of articles related to 'cultivation increases rainfall' references from the United States and Australia in the nineteenth century.

Date	Title of article	Newspaper	State or Colony	Source
12/24/1880	Does Cultivation Increase Rainfall?	<i>The St John Weekly News</i>	Kansas, USA	Samuel Aughey, PhD, LLD ^a
7/6/1882	Does Cultivation Increase Rainfall?	<i>The Shoalhaven Telegraph</i>	NSW	Samuel Aughey, PhD, LLD
10/24/1887	The Great American Desert	<i>Omaha Daily Bee</i>	Nebraska, USA	General Morrow's address ^b

85 'Does Cultivation Increase Rainfall?', *Saint John Weekly News* (Kansas), 24 December 1880.

86 'Does Cultivation Increase Rainfall?', *Shoalhaven Telegraph* (NSW), 6 July 1882; the scholar Stephen Legg noticed a similar sharing of American writings related to climate issues, although he focused on the role of forests in climate change beliefs, not RFTP. See his 'Debating the Climatological Role of Forests in Australia, 1827–1949: A Survey of the Popular Press', in *Climate, Science, and Colonization*, ed. Beattie, O'Gorman and Henry, 123, 126.

87 'The Great American Desert', *Omaha Daily Bee* (Nebraska), 24 October 1887.

88 *ibid.*

Date	Title of article	Newspaper	State or Colony	Source
4/6/1888	Why Cultivation Increases Rainfall	<i>Alexandra and Yea Standard, Bobur, Thornton and Acheron Express</i>	Vic.	Excerpt from General Morrow's address
4/6/1888	"	<i>Portland Guardian</i>	Vic.	"
4/6/1888	"	<i>Euroa Advertiser</i>	Vic.	"
4/6/1888	"	<i>Avoca Mail</i>	Vic.	"
4/7/1888	"	<i>Ovens and Murray Advertiser</i>	Vic.	"
5/12/1888	"	<i>Border Watch</i>	SA	"
5/19/1888	"	<i>Western Mail</i>	WA	"
5/26/1888	"	<i>Darling Downs Gazette</i>	Qld	"
6/5/1888	"	<i>Kerang Times and Swan Hill Gazette</i>	Vic.	"
6/9/1888	"	<i>Adelaide Observer</i>	SA	"
6/12/1888	"	<i>The Colac Herald</i>	Vic.	"
6/16/1888	"	<i>Molong Express and Western District Advertiser</i>	NSW	"
6/19/1888	"	<i>Glen Innes Examiner and General Advertiser</i>	NSW	"
6/23/1888	"	<i>Launceston Examiner</i>	Tas	"
6/29/1888	"	<i>The Richmond River Herald and Northern Districts Advertiser</i>	NSW	"
7/7/1888	"	<i>The Week</i>	Qld	"
1/5/1893	"	<i>Great Southern Advocate</i>	Vic.	"

^a Review and commentary on Aughey's *Sketches of the Physical Geography and Geology of Nebraska* (published in 1880), which features discussion of rainfall increasing with cultivation.

^b On 5 October 1887, General Morrow delivered an address praising the settlement of Nebraska at the opening of the Cheyenne County Fair in Sidney, Nebraska, USA. In this speech, Morrow asserted that the settlement and cultivation of Nebraska had increased the state's rainfall.

'The Way of the Rain'

As described above, references to the popular nineteenth-century rainfall belief appeared in newspaper articles and books of the era, but the biblical-sounding phrase also appeared in a few lines of verse by A. D. T. (Adeline Dutton Train) Whitney, an American poet and writer of books for girls.⁸⁹ Whitney's poem, published in the 22 March 1884 *Friends' Review* and 114 times in American

89 A. D. T. Whitney, *Zerub Throop's Experiment* (Boston: A. K. Loring, 1871); Adeline Dutton Train Whitney, *Selections From the Writings of Mrs. A. D. T. Whitney* (Boston and New York: Houghton, Mifflin & Co., 1887); A. D. T. Whitney, *We Girls: A Home Story* (New York: Yurita Press, 1906); A. D. T. Whitney, *Real Folks* (Milk Press, 1906) and A. D. T. Whitney, *Faith Gartney's Girlhood* (Milk Press, 1906). Ada Dutton Train Whitney was the cousin of George Francis Train, a founder and promoter of the Union Pacific Railroad. 'A Human Puzzle: Some of the Achievements of George Francis Train, Traits of an Iridescent Mind Strangely Balanced Between Lunacy and Superman "Psychosis"', *Indiana Herald*, 17 September 1884, 7; Rebecca Crowe, 'A Madman and a Visionary: George Francis Train, Speculation, and the Territorial Development of the Great Plains', *Great Plains Quarterly* 34, no. 1 (2014): 35–6, doi.org/10.1353/gpq.2014.0003.

newspapers between 1884 and 1887 (Figure 4), embodied many of the elements of the doctrine, including the suggestion that the proliferation of rain after ploughing the soil was a divinely ordained process. The same poem, cited below, also appeared in at least nine Australian newspapers between 1884 and 1895 (Table 4).

The Way of the Rain

I heard an old farmer talk one day,
Telling his listeners how
In the wide new country far away,
The rainfall follows the plow.

As fast as they break it up, you see,
And turn the heart to the sun,
As they open the furrows deep and free,
And the tillage is begun,

The earth grows mellow, and more and more
It holds and sends to the sky
A moisture it never had before,
When its face was hard and dry.

And so, wherever the plowshares run,
The clouds run overhead,
And the soil that works and lets in the sun
With water is always fed.

I wonder if that old farmer knew
The half of his simple word,
Or guessed the message that, heavenly true,
Within it was hidden and heard?

It fell on my ear by chance that day,
But the gladness lingers now,
To think it is always God's dear way
That the rainfall follows the plow.

A. D. T. Whitney⁹⁰

90 A. D. T. Whitney, 'The Way of the Rain', *Friends' Review* 37, no. 34 (1884): 542.

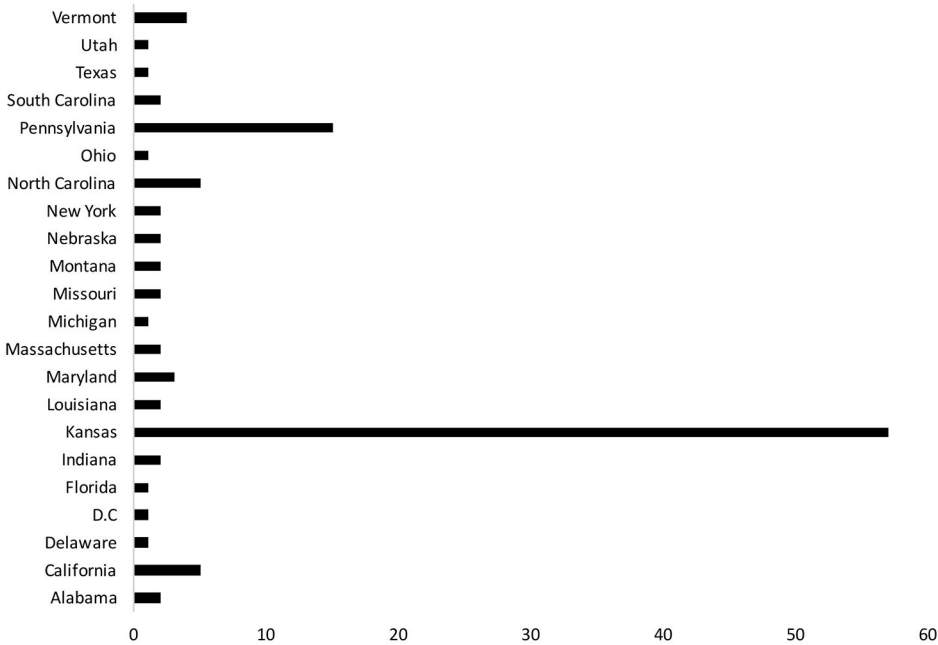


Figure 4: US states where ‘The Way of the Rain’ was published between 1884 and 1892.

Source: The author.

Table 4: ‘The Way of the Rain’ by A. D. T. Whitney appearing in Australian newspapers.

Date	Newspaper	Location
3 May 1884	The Queenslander	Brisbane, Qld
2 July 1884	The Burrangon Argus	NSW
1 Sept 1886	Newcastle Morning Herald and Miners' Advocate	NSW
15 June 1895	Weekly Times	Melbourne, Vic.
28 June 1895	Warragul Guardian	Warragul, Vic.
4 July 1895	Cobram Courier	Vic.
5 July 1895	The Broadford Courier and Reedy Creek Times	Broadford, Vic.
6 July 1895	Ovens and Murray Advertiser	Beechworth, Vic.
19 July 1895	Quorn Mercury	SA

Source: The author.

Dissemination of a myth

This essay examined an array of factors at play in the re-emergence and transformation of an ancient doctrine—that cultivation of the land could stimulate rainfall—into a belief system whose implications impacted the settlement of arid regions thousands of miles from each other, in a day when newspapers were a primary source of information. The maxim 'rain follows the plow/plough' represented a potent distillation of the religious and patriotic sentiment that helped drive settlement of the American West and Australia (particularly South Australia).

It could be said, regarding the settlement of the Great Plains of the United States, that a belief in American exceptionalism, the virtue of manifest destiny and the desirability of exploiting the natural resources of the West became entangled in a belief system that furthered settlement of the North American continent at the expense of homesteaders and the environment. Promotion of 'rain follows the plow' was, in its essence, a propaganda campaign that preyed upon those who wanted to believe that the West would become a personal Garden of Eden if they just ploughed hard enough. Similar dynamics were likely at work in Australia, particularly in South Australia.

At the time of Great Plains settlement, American science was in flux. At the end of the nineteenth century and the beginning of the twentieth century, US science was in the process of professionalising. Science was moving slowly from being the province of amateurs to becoming a profession with distinct disciplines, professional organisations, journals and meaningful degrees—a profession rigorously taught by professors who themselves were highly educated professionals. Nineteenth-century science education was too much of a hotchpotch for the average citizen to have been able to discern confirmed knowledge and real expertise.

Dissemination patterns of the RFTP belief in American and Australian newspapers were similar in many respects: articles in favour and articles criticising the belief appeared in the newspapers of both countries. According to data examined in the course of this research, the belief appeared to diminish more quickly in Australia—or at least it disappeared more quickly from Australian than American newspapers. The highest peak of RFTP coverage was between about 1875 and 1894 in both countries. By 1894, RFTP coverage in Australia had diminished more than fivefold. Whether this was because of the drought years of 1880–86 and 1888, because of the publication in newspapers of informative parliamentary debates on RFTP, or for other reasons is unclear, but the suggestion that debates discussing the pros and cons of the belief impacted its viability is intriguing and worth examining further.

In the United States, newspaper references to RFTP declined more slowly than in Australia. RFTP references in the United States surged slightly between 1904 and 1914, by which time negative or sceptical newspaper references to the doctrine had

begun to dominate the coverage. By the time of the US Dust Bowl, negative/sceptical references to RFTP in American newspapers were at least sevenfold more abundant than positive/hopeful references. This pattern suggests that, although the belief was losing strength, it might have taken a disaster like the Dust Bowl to eliminate the belief entirely from the American psyche. Additional research is necessary before this hypothesis can be established with any degree of certainty.

Positive coverage of ‘rain follows the plow’ eventually disappeared from American newspapers. The final death knell for the doctrine in the United States might have been sounded by an article written in 1908 by the prominent reporter William E. Curtis, who wrote for *The Star* (Washington, DC). His article reported that an unnamed US agriculture agent had said: ‘to send poor, land-hungry people out on these lands as homesteaders and to sell the adjoining railroad lands at the [high] prices ... is cruelly heartless’.⁹¹ The tone of this article, which mirrored Powell’s earlier expressions of concern for poor farmers attempting to settle the Great Plains, was republished and widely circulated. Still later in the twentieth century, the prominent Washington, DC, columnist Paul Mallon dealt the RFTP philosophy a coup de grâce in his article describing the practice of dry farming, the use of certain techniques adapted to farming on arid lands, as ‘dry propaganda’.⁹²

Application of a science communication framework

Kahan and associates’ research suggests that the overwhelming amount of scientific knowledge in circulation and the concomitant difficulty distinguishing good scientific information from bad contributes to a poor public understanding of science. Kahan does not consider the intentional promulgation of misinformation to be a significant driver of decisions requiring scientific knowledge. Much RFTP messaging in the nineteenth century, however, appears to have involved propagandising by those who wished to profit from the settlement of the West. The research of Pennycook, Rand and associates regarding the impact of repetition on the acceptance of misinformation supports a conclusion that the repetition of RFTP doctrine in a multitude of newspapers played an important role in the promulgation and persistence of the message.

91 William E. Curtis, ‘Dry Farming Costly, Cruel to Tempt Poor Men, Big Farms and Much Money Needed to Make Them Pay, Stump Land in the Northwest Far Better, Farmers are Growing Wiser’, *Evening Star* (Washington, DC), 22 December 1908; The Department of Agriculture official ‘who shielded himself from criticism by anonymity’ is referenced in John L. Cowan, ‘Desert Farming Without Irrigation’, *Technical World Magazine*, 204, available at play.google.com/books/reader?id=27dMAAAAYAAJ&hl=en&pg=GBS.PA204.

92 Paul Mallon, ‘News Behind the News—Drought Delusions’, *Great Falls Tribune* (Cascade, MT), 6 August 1936.

The history noted herein suggests that the following factors (see Table 1) played a role in the persistence of and reliance upon RFTP beliefs:

- Factor 1: The public's capacity and/or willingness to comprehend and converge collectively on what constitutes valid (for the era) scientific evidence: During settlement of the Great Plains, American science was in a state of flux. Many scientists did not have an adequate understanding of the established scientific principles of their era. Without adequate knowledge themselves, they were incapable of instructing the public on known principles of science. Without adequate instruction, the public was not capable of comprehending valid scientific evidence and making decisions based upon that evidence rather than on belief. Also implicated were external factors, such as the political environment, the role of the railroads and the impetus of manifest destiny—all of which might have impaired the public's ability to evaluate evidence contradicting the RFTP doctrine.
- Factor 2: Failure of scientists to explain scientific principles accurately or effectively: In the early to mid-nineteenth century, American science was evolving. Scientific training, in many colleges and universities, was repetitious and rudimentary. Scientific knowledge was limited and many of the advances made in Europe had not been fully incorporated into the average American curriculum. Many scientists did not themselves have adequate scientific education or training. Therefore, their level of expertise was insufficient to convey an adequate understanding of science to the public.
- Factor 3: Preference for, or dominance of, religious or other belief systems when deciding scientific matters: During the years when RFTP was ascendant in the American and Australian press, evocations of religious beliefs and folk beliefs appeared to have more influence than science on the public understanding of Great Plains or South Australian climatology. It is possible, however, that due to a lack of exposure to reliable science, the ordinary individual had no basis to distinguish between science and belief.
- Factor 4: The 'illusory truth effect', the impact of repetitious messages: The frequent publication of articles criticising and diminishing the value of knowledgeable individuals like Powell, the relentless drumbeat in favour of the RFTP doctrine (found in articles and poetry published in American and Australian newspapers of the era), likely impacted all who read or heard about this newspaper coverage.
- Factor 5: Resistance to the authority of valid (for the era) scientific evidence: Aughey and Wilber (and others) actively resisted and attempted to diminish the value of Powell's knowledge and advice. In Australia, the fieldwork of the government surveyor Goyder was resisted and ignored in preference for a folk belief that favoured settling and cultivating the northern reaches of South Australia.
- Factor 6: The action of witting or unwitting transmission of misinformation due to orchestrated or unorchestrated misinformation: Whether what appeared to be a campaign to amplify the RFTP message was witting or unwitting is difficult to prove. However, a number of scholars have concluded that this campaign was witting and orchestrated, particularly by those who stood to profit from the hapless homesteaders who bought and attempted to settle lands in the Great Plains region and the northern reaches of South Australia.

- Factor 7: The impact of public engagement on the public understanding of scientific issues: The publication in South Australia of parliamentary debates on the pros and cons of RFTP might have increased the willingness of the public to question RFTP. Determining whether this might be true requires additional study.
- Reality check: In both the United States and Australia, it took a dose of reality, in the form of drought, for the RFTP belief to begin losing its cachet. In the United States, the belief persisted, to some degree, until the Dust Bowl.

The survey of American and Australian newspaper coverage (and selected writings by Aughey, Wilber and Whitney) included herein brought together in a new way both previously studied and more obscure information about the RFTP belief system, its promoters and its believers. While Aughey and Wilber have been referenced by other scholars, this essay explored their backgrounds more deeply, from the reality of their limited education and scant knowledge of science, to the ways in which they ‘branded’ themselves as men of science whose advice and counsel was believed in spite of their dubious credentials and limited knowledge.

Limitations

This essay did not claim to be a detailed study of the meteorological, geographical, environmental or climatological characteristics of the regions referenced. It presented a brief survey of historical American and Australian coverage of RFTP beliefs as well as a framework for the examination of historical scientific messages—including environmental messages.

Due to space limitations, a more detailed exposition of the Australian RFTP experience, including an exploration of the status of Australian science as well as the journalistic, commercial and scientific networks through which RFTP messages migrated to Australia, could not be included; nor could a discussion of the distribution of the RFTP doctrine in other regions (such as the grasslands of Canada) be included. The Australian newspaper data (much of which pertains to the colony of South Australia) was an unexpected discovery that illustrated how far scientific misrepresentations or misunderstandings were capable of spreading—even in the nineteenth century. This topic certainly merits further discussion in the future.

Another limitation of the study is that the analysis of the articles themselves was not granular. The articles were not categorised as to type (editorial, letters to the editor, reportage or other category of article) nor were characteristics such as the length or position of the article on the page examined. A more detailed analysis would have been possible—and interesting—but the focus here was on

a preliminary exploration of historical messages about science-related matters and the introduction of a proposed framework with which these messages could be examined in more detail.

Last, but not least, the database research was limited by the contents of the databases themselves. Neither newspapers.com nor Trove represent themselves as complete repositories of all newspapers published in the regions they cover. It should be noted that, because such databases are often updated, the newspapers.com and Trove searches were conducted anew during the revision process. As a result, there were some changes in the data—including the addition of data regarding the frequency with which 'The Way of the Rain' was published in American newspapers.

Future directions

Future directions include application of the framework proposed herein as a foundation for content analysis with which to examine the RFTP articles collected in connection with this essay. Coding sheets, the basis for content analysis, could easily be prepared based upon the framework provided herein. Further exploration of the history surrounding publication of Whitney's poem "The Way of the Rain" might also be a productive topic. Was publication of this poem part of a concerted public relations effort by Union Pacific or other boosters of Great Plains settlement? A few, rather obscure texts mention the relationship between Whitney and her cousin, the Union Pacific official George Francis Train, but the significance of this connection vis-à-vis dissemination of the poem is not clear. In addition, the way in which news coverage personally and professionally demeaned the roles and expertise of Powell, Goyder and other knowledgeable scientists should be explored further. Compilation of circulation statistics for the relevant newspapers would assist in several of these analyses.

The framework or rubric proposed herein can be applied to historical instances where the public understanding—and application—of science was hindered by factors modern researchers study in their empirical work. It should be noted that, although Kahan maintained that 'orchestrated misinformation' is not one of the most significant factors contributing to 'the science communication problem', there have been critical junctures in history where witting or unwitting exploitation of inadequate scientific knowledge has been used to shape public policy—severely impacting individuals who relied on others for the expertise necessary to make important science-related decisions. These instances should be studied and the knowledge gained applied, as appropriate, to current studies of our science communication environment. The framework presented in this essay can be used in such studies and refined. Hopefully it will prove useful in other explorations of historical representations (or misrepresentations) of science.

TIGER HUNTRESSES IN THE COMPANY RAJ: ENVIRONMENTALISM AND EXOTIC IMAGININGS OF WILDLIFE, 1830–45

VIJAYA RAMADAS MANDALA

Department of History
University of Hyderabad

Abstract

This article examines the history of huntswomen in colonial India in relation to nature, imperialism and forest fauna from 1830 to 1845. In taking British women's hunting pursuits and environmental thinking as its focus, this study considers an activity often overlooked in assessments of women's contributions to colonial practices and dismissed almost entirely in accounts of imperial masculinity that take hunting as their subject matter. Moving beyond the framework of current historiography, this study intends to locate the presence of tiger huntresses in the 1830s and 1840s during the heyday of East India Company rule. The scope of this study also effectively contrasts the actions of British huntswomen in Britain and in India. Second, examining the Eden sisters in the spectacles of big game hunting during the Company Raj demonstrates the nature of British women's thinking towards Indian wildlife, which was also shaped by their political affiliations and family backgrounds in Britain, when they moved from Britain to India. Taking the subfields of the cultural and political ecology of India, this study illustrates how British women in this period articulated their exotic imaginings regarding Indian wildlife, such as tigers, elephants and wild pigs, that offers a fresh perspective to the reader. Hunting on the backs of elephants during the Company Raj also illuminates how the war functionalities of elephants that had existed in the eighteenth and early nineteenth centuries had faded away by the later period.

Keywords: hunting, women, India, wildlife, colonialism

Introduction

Historically, hunting as a kind of habitual cultural activity was practised by primitive and hunter–gatherer societies, as well as by members of ruling classes and privileged groups, in several regions across the world. Among the primitive societies, hunting was the chief subsistence activity. Among the ruling classes, since ancient times,

it has been acknowledged ‘as a pursuit that glorified masculinity’¹ and as a symbol of ‘rule’.² In England, from medieval times hunting became an exclusive pursuit of the gentry and nobility, excluding the ordinary people in the process, often labelling them as ‘poachers’. But when Britons (a common term for the British in India) established their rule in colonies such as India, *shikar* or big game hunting also served them as an ‘idiom of the rule’ and a ‘political practice’, as well as a ruse by which to extend British control over Indian arable and marginal landscapes.³ In addition, big game hunting was transformed into ‘sport’ by colonisers, excluding ordinary Indians and pushing native *shikaris* (local hunters) and indigenous tribes into the roles of ‘hunting assistants’ and ‘helpers’ to the British by the late nineteenth century.

Hunting was described in detail in relation to the landscape, environment and wild fauna of the Indian empire and was elaborated into a conscious male-dominant colonialist discourse through the vast corpus of writing left by British imperial hunters, who were also officers, administrators, soldiers and planters. Accordingly, the British male hunter was described as the upholder of true masculine traits in the colonial world, when facing off against big game animals such as the tiger, leopard or the ‘rogue’ elephant, wild boar or rhinoceros, at the same time safeguarding the native populace against the onslaughts of these dangerous animals. Thus, it is unsurprising that such British men were instrumental in establishing big game hunting as a privileged colonial political practice, as well as in positioning such practice within the realm of ‘sport’ and British imperialism. Given this context, we might wonder, what about the role of British women in big game hunting in colonial India? Did women hunters exist during the Company Raj? The Company Raj refers to the period under British rule from 1757 to 1858, while this study refers to the period between 1830 and 1845. *Shikar*, as used in this study, refers to big game hunting, or hunting for large sport in India.⁴ Other questions this study aims to explore include when and how did British women pick up the rifle to shoot ferocious animals such as the tiger or any other wild game? Is there a difference between women hunters and their hunting discourse in the Company period vis-à-vis the British Raj (i.e. colonial India, 1858–1947)? What is the underlying principle for British women participating in big hunts? What was the attitude of British women towards big game animals of the Raj, for example, the tiger and

1 Elahe Haschemi Yekani, *The Privilege of Crisis: Narratives of Masculinities in Colonial and Postcolonial Literature, Photography and Film* (Frankfurt and New York: Campus, 2011), 87.

2 Barbara Schrodt, ‘Sports of the Byzantine Empire’, *Journal of Sport History* 8, no. 3 (Winter 1981): 40–59; Charlotte Manning, *Life in Ancient India* (London: Smith & Elder, 1856), 102.

3 See John William Kaye, *The Life and Correspondence of Henry St. George Tucker, Late Accountant-General of Bengal, and Chairman of the East India Company* (London: Richard Bentley, 1854), 43; C. E. Gouldsbury, *Tiger Slayer by Order: Digby Davies, Late Bombay Police* (London: Chapman and Hall, 1915), 28; A. E. Stewart, *Tiger and Other Game—The Practical Experience of a Soldier Shikari in India* (London: Longmans, Green & Co., 1927), ix; J. T. Newall, *Scottish Moors and Indian Jungles: Scenes of Sport in the Lews and India* (London: Hurst and Blackett, 1889), 191.

4 www.collinsdictionary.com/dictionary/english/shikar, accessed 15 August 2019.

the elephant, or any other forest fauna? To what extent did big game hunting in a colonial situation enable British women to disrupt gender hierarchies, even as they stood as active collaborators in justifying British imperialism? This study will analyse this set of questions with the help of some previously neglected texts by focusing on British huntswomen in colonial India as the principal subject of inquiry.

Before examining the subject of huntswomen in the Company Raj, this study proposes that hunting as an active pursuit was taken up by women earlier than historians have acknowledged. The hunting field for females laid emphasis on equestrian skills and a passion for the chase in England as early as 1787.⁵ A nineteenth-century woman writer even opined that ‘A hunt is the most democratic of all conservative England’s increasingly republican institutions’,⁶ and there was no better thing than female participation in an arena that was chiefly dominated by males. Among women from privileged sections of society, it was not uncommon for them to ride a horse and lead the hounds to the hunting field. Some manuscripts from the fourteenth century then in the British Museum mention women ‘in the open field, on horseback and on foot’ and their ‘following the game without masculine assistance’.⁷ Such examples can be found in later centuries too. The Tudor monarch Elizabeth I (Queen of England and Ireland, reigned 1558–1603) was fond of the equestrian chase, and in her lifetime was strongly disposed to long hours of hunting. Elizabeth believed that characteristics such as resilient ‘energy’ and ‘skill’ gained from hunting were also a regal representation of her authority in politics and government.⁸ Whenever season and climate permitted, she took an active interest in hunting parties, organised by a trusted nobleman, as diversion from courtly politics.⁹ For Elizabeth, the regular practice of hunting in the English countryside not only provided the quality of steadfastness in riding horses and managing the hounds, but also the reflection of grace and courage she had shown to the rural inhabitants. The underlying aspect here is how a Tudor queen did not shun the masculine trait of the equestrian chase, and instead carried out bucolic inspections and visited people under the guise of hunting. It demonstrates the political and strategic value of hunting among the Tudor ruling elite.

In the later eighteenth-century England, Emily Mary Cecil, Countess of Salisbury, maintained a pack of dwarf hounds at Hatfield for the purpose of hunting on her estate. She was generally believed to have been the first female Master of Hounds in England.¹⁰ On her home turf in Hertfordshire, Lady Salisbury held the office

5 Harriet Latham, ‘Ladies in the Hunting-Field. 1787–1887’, *Peterson’s Magazine* (Philadelphia, PA) 92, no. 5 (1887): 415.

6 *ibid.*, 418.

7 *ibid.*, 415.

8 *ibid.*

9 *ibid.*, 416.

10 Erica Munkwitz, “‘The Master is the Mistress’: Women and Fox Hunting as Sports Coaching in Britain”, *Sport in History* 37, no. 4 (2017): 10, doi.org/10.1080/17460263.2016.1273846.

of Master of the Hatfield Hunt from 1775 until 1819, when she was 70 years old.¹¹ Lady Salisbury's hunting party was a 'theatrical spectacle'. Her servants dressed in 'sky-blue livery with black collars, lappels, [*sic*] and jockey caps', while Lady Salisbury always wore the richest and showiest of costumes.¹² This decorative aspect of the equestrian chase did not diminish Lady Salisbury's display of physical strength, when in one of the hunts she took her horse to full speed in a group of 80 horsemen.¹³ The hunt lasted about two hours until the hounds captured their prey, when Lady Salisbury and another leading horseman were the only ones steering the hounds towards the successful completion of the hunt.¹⁴ For many years in the eighteenth century, a Yorkshire squire's daughter, Diana Draper, kept the dogs in chase in an orderly manner through her voice and vigilance, acting as second-in-command to her father, who was master of the hounds in his district.¹⁵ Such kind of privilege was accessible to only a few women in England, whereas the masculine peculiarity of 'equestrian skill' and 'horsemastership' further restricted the possibilities for women's participation in hunting.

Despite the above discussion shedding light on the history of women taking part in country hunts in England, it is an undeniable fact that a strong male lobby prevailed in Britain during the nineteenth century. This sporting lobby, represented by hunting clubs, became wary of female participation in equestrian pursuits. We need to be circumspect when stating that this kind of criticism of women's participation in the hunts gained prominence, when sporting journalism was at its peak during the high decades of British imperialism in the later part of the nineteenth century. However, the aforementioned analysis still leaves unanswered the question of big game hunting in colonial India in relation to British women. What about such women confronting dangerous, hitherto unencountered beasts such as tigers and other carnivores, and large (trained) animals such as elephants? British women's discourse on environmental imaginings of flora and fauna in the empire presents a different history, when we juxtapose this with hunting in Britain. The remaining paragraphs in the article will make an attempt to redress this gap.

A range of contemporary historical works on women hunters have explored the colonial period; in particular, they have shed light on the role of British women travelling to the colonies in Africa and Asia to participate in big game hunts.¹⁶

11 *ibid.*, 10.

12 Harriet Latham, 'Ladies in the Hunting-Field. 1787–1887', 416.

13 *ibid.*

14 *ibid.*

15 *ibid.*, 416–17.

16 See Mary A. Procida, 'Good Sports and Right Sorts: Guns, Gender, and Imperialism in British India', *Journal of British Studies* 40, no. 4 (2001): 454–88, doi.org/10.1086/386264; Callum McKenzie, "'Sadly Neglected'" — Hunting and Gendered Identities: A Study in Gender Construction', *International Journal of the History of Sport* 22, no. 4 (2005): 545–62, doi.org/10.1080/09523360500122848; Mary A. Procida, *Married to the Empire: Gender, Politics and Imperialism in India, 1883–1947* (Manchester: Manchester University Press, 2002).

Kenneth Czech's *With Rifle & Petticoat: Women as Big Game Hunters, 1880–1940* examines women who made names for themselves through their hunting of a variety of big game animals around the world. Czech argues that during the nineteenth century, while women travellers witnessed or partly participated in hunts, they could not bring out their hunting adventures in print due to the difficulty of finding a publisher in a white, male-dominated sporting world.¹⁷ Second, the entering of British women into the realm of big game hunting in Africa and Asia, leaving behind their traditional gender responsibilities, was made possible by virtue of the 'explorer and companion' roles that had become available to them when they accompanied their husbands, or through performing missionary work in the colonies.¹⁸ With the creation and growth of the discipline of natural history, many museums in Europe began to collect specimens and many European men who were sent to the colonies to collect them often took their wives along with them, who in the process picked up the gun both for their own defence and for hunting wild animals in their bid to subjugate forest people to their missionary cause.¹⁹ It is against this historical background that one must analyse the emergence of women's big game hunting mores in the latter half of the nineteenth and early twentieth centuries in India and Africa.

Mary A. Procida has argued that British women's involvement in taking up firearms shows 'the development of a new model of feminine behavior' in colonial situations, which is historically worth probing because it upsets 'many accepted ideas about gender in the empire'.²⁰ Here, Procida refers to Clare Midgley's edited collection of essays *Gender and Imperialism*, which made a scholarly attempt to 'introduc[e] gender as an analytical concept into the study of empire'—a critical omission by mainstream historians.²¹ When placed in this methodological framework, British women's use of firearms should be seen as a direct engagement with empire, one that exhibited their support for the imperial cause while 'integrating themselves into the symbolic and practical politics of the Raj'.²²

Callum McKenzie's work likewise poses the question of the role of women and where they stand in the male-dominated world of hunting, whether in Britain or in the colonies.²³ Throughout the nineteenth and early twentieth centuries, he notes, shooting wildlife was deemed to be a necessary component and a demonstration of

17 Kenneth Czech, *With Rifle & Petticoat: Women as Big Game Hunters, 1880–1940* (Lanham, MD: Derrydale Press, 2002), x.

18 *ibid.*

19 *ibid.*, x–xi.

20 Procida, 'Good Sports and Right Sorts', 455.

21 *ibid.*, 458; also see Clare Midgley's introduction 'Gender and Imperialism: Mapping the Connections', in *Gender and Imperialism*, ed. Clare Midgley (Manchester: Manchester University Press, 1998), 1, doi.org/10.7765/MSI/9781526119681.01.

22 Procida, 'Good Sports and Right Sorts', 488.

23 McKenzie, "'Sadly Neglected'", 548.

masculinity. McKenzie in this context refers to the British male-dominated worldview of big game hunting, in which dangerous pursuits such as ‘alligator shooting’ and other ‘unfeminine practices’ should be undertaken by the men of sporting fraternity, thus undermining women in the process.²⁴ The well-known sporting magazine of this period *The Field* even questioned ‘whether women should be allowed to “draw blood” from sentient life’.²⁵ The foremost opponents to women’s entry into the sport of hunting were many men. Consequently, many nascent women hunters were given a hard time and vilified by influential male society in Victorian Britain.²⁶ For males and the dominant sporting press in Britain, the question was in fact one of ‘appropriate social training for adulthood’, which they considered was a restricted right and privilege available only to boys.²⁷ In this context, Anne M. Windholz’s study ‘An Emigrant and a Gentleman’ elucidates the reasons an increasing number of British males took up imperial service: ‘young men who came of age in England at the end of the nineteenth century did so as the very nature of masculinity was being contested in social, economic, and sexual arenas’.²⁸ Thus, it is understandable that British males took up lucrative colonial opportunities, as well as big game hunting as a ‘rite of passage’, a symbol of imperial power due to its popularisation in Britain and the empire. But what about women and their response to contesting a field so dominated by British males in the colonial world, as well as at home?

In this context, McKenzie’s study offers the example of a colonial huntswoman, Isabel Savory (1869–1967?), and her repeated call for freedom for ‘Diana’ to encourage women’s active participation in big game hunts.²⁹ Savory’s writing characterised ‘a departure from the male-dominated hunting literature’, as she challenged the stereotypical hegemonic and masculine hunting notions that appeared ‘in the works of Robert Ballantyne, Rudyard Kipling, George Henty and their ilk’.³⁰ Contrary to the male-dominated hunting culture that was characterised by the ‘blood and gore’ aspect of killing big game, Savory’s hunting exploits in India and Africa emphasised shooting wild animals effectively in ‘a “selective” rather than “non-selective” sporting order’.³¹

The above discussion establishes how hunting was considered a rite of passage for British males in the colonial order of empire, but begs a reconsideration of how the image of a gun in the hand represented the role of British women’s active engagement as defenders of imperialism as well as their integration into the symbolic and practical

24 *ibid.*

25 *ibid.*

26 *ibid.*, 558.

27 *ibid.*

28 Anne M. Windholz, ‘An Emigrant and a Gentleman: Imperial Masculinity, British Magazines, and the Colony That Got Away’, *Victorian Studies* 42, no. 4 (1999–2000): 631, doi.org/10.2979/VIC.1999.42.4.631.

29 McKenzie, “‘Sadly Neglected’”, 549.

30 *ibid.*

31 *ibid.*, 549–50.

politics of the Raj. I aim to examine this premise in the context of environment and empire by illustrating how hunting by British women for big game took place much earlier than the existing secondary works credit—that is, that it took place during the East India Company period. This study suggests that British women's access to the big game world, which tied them to the symbolic politics of the Raj, was achieved with the help of native servants, although this was rarely acknowledged. The Eden sisters' colonial imaginings of Indian wildlife also embodied an aspect of the state-making process on the fringes of empire. Besides, the huntswomen's thinking towards the hunted fauna differed widely from male-dominated big game hunting mores—an important historical development in relation to *shikar* in India that both Procida's and McKenzie's writings have overlooked.

Huntswomen in the East India Company period

Taking the memoirs of Emily and Fanny Eden as evidence, the present study suggests that British women in India were notable huntresses as early as the 1830s. Emily Eden (1797–1869) was the sister of the earl of Auckland, the Governor-General of India between 1836 and 1842.³² Like many members of British families, she accompanied her brother to India in 1836, spent many years in the country and wrote of her experiences, which were published as *Letters from India* (1872), in which she recounted her participation in many tiger-shooting expeditions. Both the Eden sisters' communications in the form of letters to their family in England were replete with descriptions of India's big game animals and lavish hunting expeditions that took place between 1836 and 1842.³³

Before his appointment as Governor-General of India in 1835, George Eden, first Earl of Lord Auckland, already had a considerable political reputation as President of the Board of Trade, and after completion of his Governor-Generalship he took up the post of First Lord of the Admiralty.³⁴ The Edens were one of the great Whig families (supporters of the seventeenth- and eighteenth-century British political movement that supported political and social change). They were also friends of Lord Melbourne, who after assuming the office of prime minister in 1835 had 'cancelled the Tory appointment in India and offered the Governor-Generalship to Lord Auckland'.³⁵ Auckland's appointment to India proved to be a calamity for the Eden sisters, as it disrupted their pleasant and stimulating life in England. Besides, the Edens 'were part of a large, close-knit family of sisters and brothers, nieces and

32 P. J. Marshall, 'Eden, George, Earl of Auckland (1784–1849), Governor-General of India' in *Eden, George, Earl of Auckland (1784–1849)*, Oxford Dictionary of National Biography (Oxford: Oxford University Press, 2004).

33 Emily Eden, *Letters from India ... Edited by Her Niece*, vol. 1 (London: Richard Bentley and Son, 1872), 177, 275.

34 Janet Dunbar, *Golden Interlude—The Edens in India 1836–1842* (Boston, MA and Cambridge: Houghton Mifflin Company and the Riverside Press, 1956), ix.

35 *ibid.*, ix.

nephews, cousins and near connections, with whom they kept in touch by visits and regular correspondence'.³⁶ It was due to their strong attachment to their brother that the Eden sisters accompanied him to India. This discussion of family ties and ties to the empire is pertinent here as it shows that it was the highly privileged background of the Eden sisters that enabled them to embrace and participate in big game hunting adventures, which were otherwise denied to women in the nineteenth century. In the following pages, we shall see how hunting came to be a rite of passage for British women with political backgrounds.

The lived experience of Emily and Fanny Eden in India demonstrates that, much as with British men, the early phase of the colonial period not only provided opportunities for them to try new experiences but also shaped two different kinds of mindsets. This duality is present in their understanding of big game scenes in India. In particular, Fanny Eden's role as an eyewitness and participant in big game hunts in India reveals 'her sense of adventure and quick acceptance of the odd, unexpected happenings of life'.³⁷ But this attitude of openness did not come without initial fear or bewilderment for Fanny Eden. On the other hand, while Emily Eden did not hunt tigers, she encouraged her sister to exploit all the hunting opportunities available to her in her capacity as sister of the Governor-General of India.

In one of her letters to her family in England, Emily reports that Fanny was planning a tiger shoot, which she thought sounded 'rather awful', but she advocated it for the prospect it afforded of living in tents in wild jungles, travelling on elephants and seeing wild rhinoceroses, of doing 'all the things that ought to be done in India' and for getting a good break away from humdrum life in Calcutta.³⁸ As Fanny too points out, while her sister Emily 'positively declares that nothing shall ever make her go to a tiger-hunt', she considered it 'strange and cowardly' of Fanny if she would have neglected such an opportunity.³⁹ One of Fanny Eden's travel journals describes an account of a tiger shooting trip to the Rajmahal Hills in the Bengal Presidency, which she joined 'armed with a sketchbook instead of a gun'.⁴⁰

While admitting that man-eating tigers had to be destroyed, she [Fanny Eden] found more pleasure in riding on her elephant through the rose-covered jungles which hid the great beasts. She passed through villages where no white woman had ever been before, seeing primitive [tribal] India through the eyes of a friendly, sympathetic memsahib, completely different from the stock type [of other British women] of those days.⁴¹

36 *ibid.*

37 *ibid.*, xi.

38 Eden, *Letters from India*, 275–6.

39 *ibid.*, 280.

40 Dunbar, *Golden Interlude*, xi.

41 *ibid.*, xi.

Fanny Eden's letters also inform the reader about her preparation for a *shikar* adventure near the hills, 140 miles from Calcutta, and that 'the unsophisticated population of those hills is entirely composed of tigers, rhinoceroses, wild buffaloes, and now and then, a herd of wild hogs'.⁴² She writes:

There, I'm going to live for three weeks in a tent. I shall travel the first fifty miles in a palanquin,⁴³ and then I shall march. It takes a full week to travel a hundred miles in that manner ... as our beds, armchairs, tables, and clothes all travel on the heads of human beings [Indian servants].⁴⁴

While 'secretly alarmed at the tiger-shooting part of the trip' on account of frightening stories related to the misdeeds of tigers and jungle fever, Fanny Eden was assured of a refreshing journey for a few weeks in the hills to catch-up and draw the jungle scenery.⁴⁵ Writing to a friend (Eleanor Grosvenor) in England, Fanny Eden expressed her apprehension on the upcoming hunting trip: '(the *shikar* expedition) will eventually conduct me either to the bottom of a tiger's throat or the top of a rhinoceros' horn'.⁴⁶ Emily Eden wrote to Theresa Lister in 1837 that Fanny would be going on a tiger shooting expedition with their family friend, William Osborne, in the Rajmahal Hills:

[There] they would be joining a Mr. and Mrs. Cockerell, who made one of these hunting trips every year. Mrs. Cockerell was a sharp little woman, almost pretty, and very ill-natured or so Emily had heard. But Fanny would not see too much of her, for Mrs. Cockerell was a keen tiger-huntress, and so would be out on her elephant with the men [and overseeing tiger-hunting expeditions].⁴⁷

While Emily was insistent that her sister pursue the tiger hunt, Fanny considered such hunts troubling, reiterating that 'William won't hear a reason [*sic*] as to the horrible dangers he is going to take me into'.⁴⁸ Fanny blamed Theresa Cockerell (1809–53, mentioned above) and another British woman who regularly would ride on the backs of elephants, and go out tiger-hunting every day, and in the process endangering their lives. She protests that 'they talk of the excitement of the tiger's spring, and the excellent day it was when they saw eight [tigers] killed'.⁴⁹ While Fanny did not indulge in tiger shooting, during the period of her residence in India she was a very active participant in several tiger hunts, riding on elephant back. She continued to observe Mrs Cockerell's hunting prowess along with that of the British huntsmen, describing many of their adventures, which offered them the thrill of

42 *ibid.*, 58.

43 In India and the East Asian countries, a covered litter for one passenger, consisting of a large box carried on two horizontal poles by four or six bearers.

44 Dunbar, *Golden Interlude*, 58.

45 *ibid.*, 59.

46 *ibid.*, 58–59.

47 *ibid.*, 58.

48 *ibid.*, 59.

49 *ibid.*, 59.

the hunt, as though they were almost ‘in the very jaws of the tigers’.⁵⁰ On another occasion in a safe part of the country, Mrs Cockerell had shot a tiger and returned home ‘fresher and better dressed than ever, quite delighted and only wishing’ that the tiger had shown more fight.⁵¹ The daily letters of Fanny Eden reveal the abundance of the tiger population across the Bengal Presidency, many of them classified man-eaters. During the East India Company rule in India, the act of hunting was not one that its participants seemed to regard as needing justification, although some elevated it to the status of a science by donating specimens to museums. But it was unsurprising that at an official level the Company Government found it necessary to destroy them as part of the ‘vermin eradication’ program.⁵²

Fanny refers to her hunting party going in pursuit of three ‘real good tigers’, and Mrs Cockerell proclaimed such a goal as ‘worth going after’ since tigers had eaten many of the nearby villagers, thereby alluding to the presence of the man-eater carnivore problem in the region.⁵³ The above instances show the presence of tiger huntresses during the Company period, even as the Eden sisters were settling down in India. Thus, the disruption of gender roles was not unique to just the women of the later Raj, as the writings of Procida and other scholars have implied. But such instances could already be witnessed in the early part of the nineteenth century, when many British women had gone in pursuit of tigers—the most favoured pastime for early Britons in India.⁵⁴ The letters written by the Eden sisters in India also elucidate how observation of the Indian environment derived from the imagination of British women and how its meaning was transmitted by reinforcing Britons’ view of empire as an enchanting and exotic place. British women’s interaction with the political and cultural ecology of India also lent them a certain legitimacy with which to maintain coherence and support for the colonisation and control of fringe and arable landscapes.

Fanny Eden, along with other British huntresses of this period such as Mrs Cockerell, enjoyed a key political endorsement relating to the epicentre of imperial power in India (i.e. tiger hunting). The Eden sisters’ writings and experience in the hunting field also transcend the intersection of class, race, imperial power and gender privilege as early as the 1830s. Besides, they underscore their textual engagement and growing interest in the business of empire, as witnesses to colonial history-in-the-making, class and racial identity (of Englishness) in India as part of British

50 *ibid.*, 69.

51 *ibid.*, 73.

52 Bengal Rev (LP) 10 Sept 1828, draft 472/1827–28, 243–45. IOR/E/4/723. British Library (BL); Bombay Pol. 1 Jun 1842, Draft 303/1842, 663–89. IOR/E/4/1070. BL; also see John B. Seely, *The Wonders of Elora* (London, G. and W. B. Whittaker, 1824), 376–7; Jubulpore Roads, Mirzapore, Measures for Destruction of Tigers (1834–1837). OR/Z/E/4/14/R495. BL; Gratuities to Families of Victims Killed by Tigers and Wild Beasts, 345, 645. IOR/Z/E/4/16/W177 and IOR/E/4/760. BL.

53 Dunbar, *Golden Interlude*, 74.

54 *ibid.*, 58, 59, 61, 95.

colonial authority. The liability and blame attached to hunting whenever a wild animal was killed, but equally a desire to appreciate the aesthetics of Indian cultural ecology, also offer a 'representational equilibrium between rhetorical detachment and colonial involvement'.⁵⁵ Angelia Poon, while observing such historical interplay as an example of colonialism's politics of performance, points out that the 'link between seeing and knowing, long a crucial feature of the Western metaphysical tradition of cognition, underpins colonial epistemology as well'.⁵⁶ In the case of Fanny Eden, the dynamics of seeing and knowing as a thoughtful bystander and participant, as someone from a colonial power, extends an important dimension in the colonisers' venture in creating the colonial knowledge of animal realms in relation to the Indian environment.

Her years of experience and familiarity with the tiger hunt made Fanny Eden develop an unusual liking for elephants. According to her, these animals possessed 'intelligence' and 'resourcefulness', but 'she regretfully observed that she could not extend [this admiration] to tigers, alligators or snakes'.⁵⁷ It is noteworthy that British women were no exception when it came to holding the belief that predatory animals such as tigers, alligators or wild pigs needed to be vanquished, while elephants were friends for their invaluable use to the British in tiger shoots and military expeditions during this period. From a hunting camp, Fanny Eden writes:

We are staying here [in the jungle], excessively baffled by the tigers. They saw one large one yesterday afternoon, but in such thick jungle, the elephants could not make their way after him ... There was something grand in the way all the elephants set off stamping and screaming, and follow[ed] up the traces of a tiger in jungles where it seems a sin and a shame to fancy a tiger could be [hiding in] soft grass, with clumps of rose bushes white with roses, and thousands of butterflies hovering over them.⁵⁸

Elephants are the best beasts to see much of—I cannot say the respect I have for them. Though not naturally witty I suspect they have much more common-sense than we [humans] have.⁵⁹

This depiction of the character of elephants and tigers in the case of Fanny Eden's experience in the forest is noteworthy. She was inadvertently reflecting broader British attitudes towards India's two magnificent beasts, as enshrined in the colonial program of hunting and preservation—an aspect of this program that continued to

55 Angelia Poon, *Enacting Englishness in the Victorian Period: Colonialism and the Politics of Performance* (London: Routledge, 2008), 75.

56 *ibid.*, 77.

57 Dunbar, *Golden Interlude*, 48.

58 *ibid.*, 75.

59 *ibid.*, 75.

mirror the official mindset of the British Raj.⁶⁰ In the above-mentioned occasion, Fanny Eden was inferring that while to a naturalist's eye the forests of India were sublime and striking with their variegated flowers and non-predatory wildlife, they also had 'brute' and 'dangerous' animals such as tigers lurking behind soft grass and rose bushes. The implication here is that the natural environment of India, despite its external aesthetic value, also provided a safe haven to dangerous beasts of prey. To extend John Miller's claim to the present study, the modern environmentalism reckoned through Fanny Eden's ecological sensibilities illustrates her attempt to colonise 'landscape with beauty and mystery, with the kind of otherness that makes wilderness vital to romance and which is far harder imagined in intensely managed, charted and cultivated lands'.⁶¹ In a way, for the British in India, the romantic sojourn happened in the real wilderness with its thriving biodiversity on the peripheries of empire. Accordingly, this study contends that Fanny Eden's experience offered the nostalgia of imperial romance (i.e., the idea of the exotic and the unknown) for British women in the early nineteenth century, which was not found at home in Britain.

As Pramod K. Nayar, too, illustrates, the English sportswoman's hunting expedition 'narrates the Indian wilds through the aesthetic of the luxuriant, an aesthetic that combines beauty with danger'.⁶² Hunting encounters with wild animals meanwhile were portrayed as 'an aesthetic risk'.⁶³ This aspect explains the background that despite the risky pursuit of hunting, the forest environment offered a healthful recreation; even as the flora presented a sublime view, the wild predators inhabiting these jungles posed a danger or challenged the prowess of a hunter or a huntress. It also raises the question of extending British control over forest interiors. This kind of early construction in colonial imaginings of the Indian wilderness changed after the 1857 revolt. The luxuriant forest then became the object of the colonial project of empowerment, conquest and control. This would attest to the fact that the earliest aesthetic picturesque of Indian forests eventually was made into a testing ground to implement key imperial ideologies in India. One sees this shift taking place as the British gained interest in the acquisition and stewardship of territory, conservation and ecological policies from the 1860s onwards. Such a transition became enshrined in policy with the establishment of Indian Forest Service in 1864.⁶⁴ This article argues that colonial knowledge and power relationships were applied to wild animals

60 Mahesh Rangarajan, 'The Raj and the Natural World: The War against "Dangerous Beasts" in Colonial India', *Studies in History* 14 (1998): 265–99, doi.org/10.1177/025764309801400206; Vijaya Ramadas Mandala, 'The Raj and the Paradoxes of Wildlife Conservation: British Attitudes and Expediencies', *Historical Journal* 58, no.1 (2015): 75–110, doi.org/10.1017/S0018246X14000259.

61 John Miller, *Empire and the Animal Body: Violence, Identity and Ecology in Victorian Adventure Fiction* (London: Anthem Press, 2014), 30.

62 Pramod K. Nayar, *English Writing and India, 1600–1920: Colonizing Aesthetics* (London: Routledge, 2008), 6, doi.org/10.4324/9780203931004.

63 Nayar, *English Writing and India*, 6.

64 *ibid.*; also see Benjamin Weil, 'Conservation, Exploitation, and Cultural Change in the Indian Forest Service, 1875–1927', *Environmental History* 11, no. 2 (2006): 319–43, doi.org/10.1093/envhis/11.2.319.

and their environments in the narratives of the Eden sisters and, later, other British sportswomen in the later nineteenth and early twentieth centuries. These accounts demonstrate that the colonial construction of India, which granted particular roles for imperial governance and political authority, likewise was put in place by their construction of Indian forest territories through an aesthetic, ecological mode.⁶⁵

Another feature of the big game hunting scene that Fanny Eden witnessed was the trumpeting and warlike nature of the Company Raj's *shikari* elephants whenever they were marched into the forest in search of hunting opportunities. A British account of hunting scenes in India prior to 1833, too, reports on the suitability of employing such elephants in big game shoots:

No conveyance can be more delightful, or better suited to the country; from the altitude gained by mounting a tall elephant, we [i.e. the British hunting party] command a vast extent of prospect, and there is a feeling of perfect security, arising from the extraordinary sagacity of the animal, which in the wild passages of these uncleared jungles, is very satisfactory.⁶⁶

This illustrates how the British found elephants the best and safest method of transportation in the jungle interiors. Such hunting expeditions were accompanied by a number of *chuprasies* (peons or servants) and *chobedars* (masters of ceremonies) wearing a variety of ornamental clothing (white clothes and red turbans), and carrying swords and silver maces.⁶⁷ But an interesting aspect of the above discussion is its reference to 'uncleared jungles', which accentuates the implication that the Indian marginal landscapes were still unscathed by colonial encroachment, even though hunting expeditions were taking place for pleasure.

The skill of Britons was not just that of men and women who brought down tigers, rhinoceroses, alligators or wild pigs with their guns, but that of *shikari* elephants of the Company Raj, which would retaliate with ferocity and sagacity, especially when they were charged by any predatory animals.⁶⁸ As Fanny Eden writes:

The gentlemen have with them each six rifles in their [elephant] howdahs and shoot at all the innocent wild beasts they meet. Just as I was [looking] upon the exceeding beauty of one rose bush, a great wild hog rushed out of it and charged the elephant Mrs. C[ockerell]. and I were upon. The instant after, it had five balls through it and then I settled that I had no taste for the shooting part of the expedition, and shall confine my genius to the picturesque, and there is more than enough space for it here.⁶⁹

65 See Alan Gardner, *Rifle and Spear with the Rajpoots: Being the Narrative of a Winter's Travel and Sport in Northern India* (London: Chatto and Windus, 1895), doi.org/10.5962/bhl.title.17641; Isabel Savory, *A Sportswoman in India—Personal Adventures and Experiences of Travel in Known and Unknown India* (London: Hutchinson, 1900), doi.org/10.5962/bhl.title.33466; Dunbar, *Golden Interlude*.

66 'High Life in the East. No. II. Hawking', *The Court Journal: Gazette of the Fashionable World*, 11 May 1833, 315.

67 *ibid.*

68 Dunbar, *Golden Interlude*, 70–3.

69 *ibid.*, 70.

Referring to one of the hog-hunting episodes, Fanny Eden writes:

I thought that hog's was a shocking case of murder ... *The elephants set to work to trample it [the wild hog] to death, and when at last it was dead, they insisted upon my looking at it.* It seemed to be such a fine strong beast, so exactly fitted to its own jungles. I do not see our [Britons'] right to take our love of destruction there.⁷⁰

This observation of a 'live hunting expedition' is interesting also as a first-hand account of 'what must have been a unique experience for a high-bred Whig lady' such as Fanny Eden.⁷¹ Her criticism of the destruction of Indian wildlife by her fellow Britons was clearly shown in this instance of hog-hunting, which she believed to be no less than a 'shocking case of murder'.⁷² She was equally surprised at how Indian elephants were trained in the art of hunting, as their actions of trampling wild hogs or fiercely retaliating against rhinoceroses would seem to suggest.⁷³ She further writes, 'if I were given to shooting, I would shoot deer and peacocks without having fifty elephants to help me', protesting against *shikari* elephants making such a grand show in the forest.⁷⁴ It is pertinent to note here that the instances of *shikari* elephants discovering the whereabouts of tigers in the shrubs of the jungle or charging back at any intimidating wild animal are confined to the East India Company period. Elephants in the later period were not trained to carry out such acts.

Thomas R. Trautmann's deliberation on the institution of the war elephant in the context of environmental history is germane here.⁷⁵ His study suggests that unlike in other parts of the world, such as China and Africa, elephants in India took part in some of the greatest wars of antiquity—a history that spans more than 3,000 years, which went beyond India onwards to Persia, and then to Europe. Since elephants eat such massive quantities of food, it was unprofitable to raise or maintain them. By introducing the native knowledge system of domestication, the Indian kings captured wild adults and trained them, using trained elephants for official purposes, inspecting the provinces, rituals, royal hunts and in warfare. The rulers of India found an intelligent strategy to sustain wild elephant populations. The 'elephant forests' were instituted along with the invention of the war elephant. They ensured the protection of wild elephants from hunters and poachers, and 'elephant forests' were prevented from being cut down. Studying the underpinning of human–elephant relations and its agency, Trautmann persuasively demonstrates the structure of India's environmental history and the reasons for the presence of wild elephants in its forests over the past two millennia. Safeguarding wild elephant populations with domesticated and trained ones was a political practice with regal sanction, and was

70 *ibid.*, 70 (emphasis added).

71 *ibid.*

72 *ibid.*, xi.

73 *ibid.*, 72–3.

74 *ibid.*, 74.

75 Thomas R. Trautmann, *Elephants and Kings: An Environmental History* (Chicago: University of Chicago Press, 2015), 45, 46, 51, doi.org/10.7208/chicago/9780226264530.001.0001.

continued even up to the arrival of the British. It is with this backdrop that Britons in India continued to exploit elephants in hunts as well as for various other tasks, thus consciously deriving their ruling licence from pre-colonial Indian traditions. John M. Kistler observes that ‘the training of war elephants probably parallels the training of pachyderms for tiger hunting’,⁷⁶ as is evinced by the case of the Company Raj’s elephants, discussed above.

What is noteworthy, then, is Fanny Eden’s figuring out of the role of Indian elephants in *shikar* from a British woman’s point of view. The nature of violence from an animal (elephant) meted out to another forest animal (wild hog) also underscores the predatory care of the Company Raj and its adaptation to the physical environment of India. Fanny Eden’s account of *shikari* elephants also emphasises, to borrow from Sujit Sivasundaram, an anthropomorphic gaze in observing an animal’s character and temperament, and an anthropomorphic bent in relation to Britons’ understanding of India’s flora and fauna.⁷⁷ This manifestation of new and hybrid forms of information was crucial to making colonial knowledge in relation to the ecosystems of the Indian subcontinent. Besides, the negotiation between British huntswomen (as illustrated by Fanny Eden) and natural knowledge was unleashed in the peripheries of empire and extended to animal realms (i.e. non-human spaces).

While Fanny Eden did not altogether indulge in big game sports, she nonetheless participated in such pursuits along with Mrs Cockerell—whose involvement also attests to the fact that many British women in the Company Raj were notable shooters of big game animals in terms of their practical experience. However, they did not record their hunting recollections, or could not publish them as the Eden sisters did, even as their role as tiger huntresses would seemingly suggest they could have done so. One possible reason for this lapse was that publishers both in England and in India during this period believed that hunting was a male privilege in the public arena, and consequently was not sanctioned by society for women. Conversely, one notable dimension of British women across various colonies was the evocation of the idea of ‘British subjecthood’, which served as ‘an imperial form of belonging, symbolically and culturally tying the disparate branches of the colonial empire to the (British) metropole’.⁷⁸ This ‘subjecthood’ in the Eden sisters’ writings, though not spelled out literally, also encapsulates Anglo-Saxon women’s political space and temporality in the cultural geography of India, fashioned by their first-time experience in Indian wilderness and its vivid flora and fauna, which reinforced their encounters with the notion of the exotic imperial ‘Other’.

76 John M. Kistler, *War Elephants* (Lincoln, NE: University of Nebraska Press, 2007), 11.

77 Sujit Sivasundaram, ‘Trading Knowledge: The East India Company’s Elephants in India and Britain’, *Historical Journal* 48, no.1 (2005): 30, doi.org/10.1017/S0018246X04004212.

78 Matthew P. Llewellyn, ‘For a “United” Kingdom and a “Greater” Britain: the British Olympic Association and the limitations and contestations of “Britishness”’, in *The British World and the Five Rings: Essays in British Imperialism and the Modern Olympic Movement*, ed. Erik Nielsen and Matthew Llewellyn (London: Routledge, 2016), 18, doi.org/10.1080/17430437.2014.990687.

Conclusion

This study has attempted to situate women's hunting activities as early as in the days of the Company Raj through consideration of the Eden sisters' accounts of tiger hunts. It should, however, be noted that continuities between East India Company rule and the later Raj continued in the form of participation in tiger hunts by the upper echelons of British women, often as wives of viceroys, governors-general and British royalty. For example, vicereines such as Lady Curzon and Lady Minto participated in such colonial hunts, which were more 'staged' and less dangerous. For example, in 1907, Lord and Lady Minto joined the Maharajah of Cooch Behar in the Bengal Presidency for a shoot, where they bagged three tigers in the morning and four in the afternoon in a single day.⁷⁹ Minto stayed for a full one week and his wife had the opportunity to shoot a tiger.⁸⁰ These hunting activities thus accentuated the colonisers' image in the empire by putting their energy and showmanship into sport befitting the rulers. John MacKenzie terms it 'female participation in imperialism',⁸¹ where *shikar* practices were remoulded and refined by the British soon after the consolidation of their political rule across India.

To recapitulate, hunting in the Company Raj offered a combination of experiences to British men and women and was available as an activity to members of the politically privileged sections of society. By creating a pan-Indian ruling identity (Anglo-Indian or the British in India), this privileged group actively participated in tiger shooting expeditions, chasing wild hogs and rhinoceroses, and even shooting alligators from the backs of *shikari* elephants. Our study has demonstrated that British women in the Company period hunted tigers and other dangerous predatory animals. However, it is evident that they did not articulate, or invent, the language of hunting as 'sport' or the semantics of 'sportswomanship'—literary symbolism in relation to actual practices—an idea that emerged only during the latter half of the nineteenth and early twentieth centuries. Likewise, there were very limited avenues for the publication of works on hunting by British sportswomen, for the reasons mentioned above. Despite these limitations, the writings of the Eden sisters during the early nineteenth century would illustrate how Britons followed the practice of big game hunting and tiger shooting on the backs of elephants. They indulged in this practice of chasing wild animals so as to invoke ecological authority over Indian marginal landscapes by mimicking the political norms and recreational gatherings of the Indian ruling elite. Hunting provided British women with a metonym for ecological empire-building and opportunities to admire the exotic beauty in the wilderness of India.

79 Nripendra Narayana Bhupa, Maharajah of Cooch Behar, *Thirty Seven Years of Big Game Shooting in Cooch Behar, The Duas and Assam* (Bombay: The Times Press, 1906), 411–13.

80 *ibid.*, 414.

81 See general introduction by John MacKenzie in Procida, *Married to the Empire*, viii.

This study has illustrated some of the most evocative examples of hunting, gender and imperialism in relation to environmental history. Participation in the equestrian chase by British women in England did not create veritable battles like those of tiger huntresses bumping into big game in colonial India. The connection between the animals of the Raj, hunting and colonialism also signified the latitude of British control over forest interiors and the symbolic conquering of the Indian environment, in which some British women had taken an active part since the days of East India Company rule. Such traditional hunting practices thenceforth continued to form a part of later British appreciation of Indian big game hunting mores.

ADAM SMITH, NATURAL EXTRACTION AND HISTORICAL JUDGEMENT: AN UNWARRANTED ENVIRONMENTAL LEGACY¹

JAMES CULLIS
University of Oxford

Abstract

Within the field of environmental history, assumptions about the development of political and economic ideas have tended to overlook the complex intellectual and historical context that gave rise to them. This article argues that this has certainly been the case in interpretations of Adam Smith by environmental historians. Through drawing on scholarship in intellectual history, this short essay reveals how Smith's evaluation of natural extraction was directly linked to his conception of political economy. In the process, it also demonstrates a need for environmental historians to reassess Smith's environmental legacy.

Keywords: Adam Smith, environmental historiography, environmental history, capitalism, Enlightenment

Adam Smith's presumed legacy regarding the issue of environmental regulation is controversial to say the least. Unfettered free-market exploitation of natural resources has tended to be the dominant narrative with which we understand his contribution to environmental debates, especially mining.² Smith's attitude towards the subject was in part motivated by a rising discussion over natural resources, especially coal consumption. Although aware of these mining debates, Smith appears to have registered minimal, if any, interest in the economic potential associated with the subject.³ Yet mining did play a considerable part in how he understood the history of political economy. In both the *Wealth of Nations* and *Lectures on Jurisprudence*,

1 This paper emerged out of a presentation given at the World Congress of Environmental History, 22–26 July 2019, Federal University of Santa Catarina (Universidade Federal de Santa Catarina, UFSC), Florianópolis, Brazil, entitled 'The Extravagance of Minerals: Adam Smith on the Pitfalls of Natural Extraction'. My thanks to Gerrado Serra, James Beattie and anonymous readers for their comments.

2 For an example of how Smith is used in contemporary debates over mining and development, see Omar Zambrano, Marcos Robles and Denisse Laos, *Global Boom, Local Impacts: Mining Revenues and Subnational Outcomes in Peru 2007–2011*, No. IDB-WP-509, IDB Working Paper Series, 2014, 2.

3 Fredrik Jonsson, *Enlightenment's Frontier: The Scottish Highlands and the Origins of Environmentalism* (New Haven, CT: Yale University Press, 2013), 174.

Smith would develop a critique of mining that rejected the commercial value of the natural resources found underground, in favour of the productive capacity of pastoral lands. Through taking Smith's writings on natural extraction seriously, there is an urgent need for the discipline of environmental history to reassess and contextualise his argument in Enlightenment debates over resource management and political economy. Since the 1970s, intellectual historians have demonstrated that Smith's work cannot be completely aligned with the underlying theory of a capitalist economy.⁴ As Reinhard Schumacher notes, modern economic interpretations of his corpus have skewed the nature of his ideas in order to fit a precise historical narrative.⁵ Here, work done by intellectual historians such as Quentin Skinner is crucial to discovering why Smith has been so misread. Through drawing on this body of scholarship, this short essay will reveal how Smith's evaluation of natural extraction was directly linked to his conception of political economy. In the process, it will also demonstrate a need for environmental historians to reassess Smith's environmental legacy.

Within the field of environmental history, assumptions about the development of political and economic ideas have tended to overlook the complex intellectual and historical context that gave rise to them. For Skinner, the sole focus on close reading without any reference to the social or historical context of a text's production obscures a full understanding of its significance.⁶ Central to this is the rejection of the notion that any historical corpus of work seeks to contribute to certain perennial philosophical questions. As an approach to the history of ideas, Skinner's argument is crucial to any analyses of Smith's attitude towards mining. A significant concern raised by Skinner is how historical arguments are often understood through a form of prolepsis—that is, reading a historical text as if it contained the seeds of future ideas, or that the author intended the text to be understood in a particular way by subsequent generations.⁷ Exploring the intellectual character of Smith's work in this light has consequences for environmental history because of the way it refocuses attention away from the perceived modern consequences of his ideas onto an examination of his original aims in writing them.

4 See, for example, Istvan Hont, *Jealousy of Trade: International Competition and the Nation-State in Historical Perspective* (Cambridge, MA: Harvard University Press, 2005); Istvan Hont, *Politics in Commercial Society: Jean-Jacques Rousseau and Adam Smith*, ed. Béla Kapossy and Michael Sonenscher (Cambridge, MA: Harvard University Press, 2015); Ronald Meek, *Social Science and the Ignoble Savage* (Cambridge: Cambridge University Press, 1976); Nicholas Phillipson, *Adam Smith: An Enlightened Life* (London: Penguin, 2011); Donald Winch, *Adam Smith's Politics: An Essay in Historiographic Revision* (Cambridge: Cambridge University Press, 1978); Donald Winch, 'Adam Smith's "Enduring Particular Result": A Political and Cosmopolitan Perspective', in *Wealth & Virtue: The Shaping of Political Economy in the Scottish Enlightenment*, ed. Michael Ignatieff and Istvan Hont (Cambridge: Cambridge University Press, 1983).

5 Reinhard Schumacher, 'Adam Smith's Theory of Absolute Advantage and the Use of Doxography in the History of Economics', *Erasmus Journal for Philosophy and Economics* 5, no. 2 (2012): 54–80.

6 Quentin Skinner, 'Meaning and Understanding in the History of Ideas', *History and Theory* 8, no. 1 (1969): 3–53.

7 Skinner, 'Meaning and Understanding', 24.

For some commentators, Smith's lack of concern with the issue reflected a general eighteenth-century lack of interest in questions relating to the natural world.⁸ Others, notably Donald Worster, whilst recognising that Smith did consider environmental questions, argue that this was only because it was instrumental to his overall economic project.⁹ Such interpretations neatly parallel a particular understanding of his place in the history of economic thought that stress a linear historical development of economic ideas.¹⁰ Seen in this light, understandings of Smith's ideas conform to a Whig historical narrative in which economic history is aligned with political liberalism.¹¹ This point is crucial in terms of providing an indication of how his commentary on environmental issues has been marginalised through an overemphasis on his economic writings coupled with a particular view of his place within the broader Enlightenment project of 'Modernity'. Through placing his attitude to mining within the context of his historical writings, this short essay allows for an exploration of the nuances and complexity of his environmental ideas.

In the latter half of the eighteenth century, political debate in Britain was shaped to a degree by the question of industrialisation.¹² As William Cavert notes, fossil fuel pollution was a significant concern for the citizens of urban centres such as London.¹³ Between 1763 and 1834, the issue of coal consumption, and by extension natural resource extraction, took a hold of domestic concerns and shaped the political agenda and wider social discourse.¹⁴ For Smith, mining played a considerable part in how he understood the history of political economy. According to some mid-twentieth-century commentators, notably Friedrich Hayek, Smith's economic arguments centred on the social benefits of individual choice.¹⁵ Yet Smith's attitude towards mining, as revealed in his writing, reveals a scepticism with regard to the profitability and necessity of such action. Understood within the context of his wider account of historical progress, Smith's arguments predominately focused on the consequences of mining on particular colonial projects. Through addressing the

8 Agnar Sandmo, 'The Early History of Environmental Economics', *Review of Environmental Economics and Policy* 9, no. 1 (2015): 46.

9 Donald Worster, *The Wealth of Nature: Environmental History and the Ecological Imagination* (New York: Oxford University Press, 1993), 214–16.

10 Schumacher, 'Adam Smith's Theory of Absolute Advantage', 68.

11 Paul Samuelson, 'Out of the Closet: A Program For the Whig History of Economic Science: Keynote Address at History of Economics Society Boston Meeting, June 20, 1987', *Journal of the History of Economic Thought* 9, no. 1 (1987): 51–60.

12 Michael Flinn and David Stoker, *The History of the British Coal Industry*, vol. II (Oxford: Clarendon Press, 1984), 449–57.

13 William Cavert, *The Smoke of London: Energy and Environment in the Early Modern City* (Cambridge: Cambridge University Press, 2016).

14 *ibid.*, xiv–xv.

15 Friedrich Hayek, *Studies in Philosophy, Politics and Economics* (Chicago: University of Chicago Press, 1967), 99, cited in Alan Ebenstein, *Friedrich Hayek: A Biography* (Chicago: University of Chicago Press, 2003), 250.

issue in these terms, Smith would go on to develop a critique of mercantilism, which was characterised by a rejection of the economic value of the natural resources found under the ground, in favour of the productive capacity of the topsoil.

In Book Four of the *Wealth of Nations*, Smith raises the problem of mining in relation to the European colonial project. In Chapter Six, he examines the motivations for the European ‘discovery’ of America—and in particular Spain’s quest for gold. For him, the Spanish drive to extract minerals brought with it both a degree of uncertainty and the absorption of capital:

It is perhaps the most disadvantageous lottery in the world, or the one in which the gain of those who draw the prizes bears the least proportion to the loss of those who draw the blanks: for though the prizes are few and the blanks many, the common price of a ticket is the whole fortune of a very rich man. Projects of mining, instead of replacing the capital employed in them, together with the ordinary profits of stock, commonly absorb both capital and profit.¹⁶

Whilst many Enlightenment commentators understood the episode as the consequence of the rise of luxury with the advent of commercial society, for Smith, alongside David Hume, the decline of the Spanish Empire was the result of a flawed overvaluing of bullion and the national accumulation of precious metal.¹⁷ Part of these concerns were to do with the cost-effectiveness of the mining process. As Smith notes in the *Lectures on Jurisprudence*:

A man who cultivates one acre, by cultivating two or a certain method of treating that one, can be almost certain of doubling his stock of corn; but he has no such certainty that by applying double industry to the mine he shall multiply in the same proportion the quantity of gold and silver.¹⁸

Through reasoning that the benefits of natural extraction were limited, Smith alluded to a significant point about his conception of the environment—namely, that financial and practical constraints arise when seeking to exploit the resources beneath the earth’s surface. These concerns centred on the belief that the pursuit of such activity was futile as the amount of geographic space where the metal was thought to be present was limited.¹⁹ This sceptical view must ultimately force environmental historians to ask why they continue to permit Smith’s ideas to be used to justify deregulation and so-called ‘economic progress’ at the expense of environmental degradation.

16 Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, vol. I, ed. R. H. Campbell, A. S. Skinner and W. B. Todd (Indianapolis, IN: Liberty Fund, 1976), 562.

17 Fredrick Whelan, ‘Eighteenth Century Scottish Political Economy and the Decline of Imperial Spain’, *Journal of Scottish Historical Studies* 38, no. 1 (2018): 59–61.

18 Adam Smith, *Lectures on Jurisprudence*, ed. R. L. Meek, D. D. Raphael and P. G. Stein (Indianapolis, IN: Liberty Fund, 1982), 345.

19 Smith, *Lectures on Jurisprudence*, 507–8.

Smith's understanding of natural extraction came out of an overarching account of societal progress. It was within this context that he revealed a cautious attitude towards the subject, driven primarily by the idea that such activity used up time and economic resources. As a substitute, Smith emphasised how European history was shaped to a large degree by the link between the urban and rural landscapes. This point is significant as it demonstrates how he saw mining to be superfluous to the needs of the modern commercial economy. In Book Three of the *Wealth of Nations*, Smith provided an account of the way in which agricultural production was stimulated by the growth of towns and cities. Here, the idea of an 'unnatural and retrograde order' took agriculture to play a significant part in the emergence of the new social environments.²⁰ In this sense, Smith's commentary on mining marked a shift in the understanding of the foundations of economic success from those based on mineral accumulation, to those driven by cultivation and land-use. Whilst historians have noted the importance of Smith's preference for the economic potential of agricultural production, they have overlooked the consequences this had on his judgement of the historical record of certain societies.²¹ Thus natural extraction was linked to the 'jealousy of trade' and the Renaissance doctrine of republican grandeur.²² It is this sense of the failed notion of competition between rival nation-states, and by extension empires, that encapsulates his critique of Spain. In the *Lectures*, Smith highlighted his concerns over the economic sustainability of mining through noting the effects of ownership on Spain and Portugal's domestic economies:

When they got possession of the mines of Mexico and Peru, they thought they could command all Europe by the continual supplies which they received from thence, if they could keep the money among them, and therefore they prohibited the exportation of it. But this had a quite contrary effect, for when money is, as it were, dammed up to an unnatural height, and there is more than the circulation requires, the consequences are very unfavourable to the country.²³

By revealing the resulting negative influence it had on their currencies, Smith drew attention to the financial cost to both states' economies. Drawing on this insight allows environmental historians to rethink the way they characterise Smith's legacy on questions of resource extraction and state investment. By reconstructing the historical context in which he wrote, this essay has revealed the need to take into consideration this point when assessing his contribution to the broader historical environmental debate. Thus Smith's attitude to mining comes out of his own prior intellectual commitments: one that was not wholly dominated by an impending

20 Smith, *Wealth of Nations*, 409.

21 Edward Wrigley, 'The Transition to an Advanced Organic Economy: Half a Millennium of English Agriculture', *Economic History Review* 59, no. 3 (2006): 477.

22 Hont, *Jealousy of Trade*, 1–2. The idea of a 'jealousy of trade' comes from David Hume's essay of the same name, which in turn was taken from Thomas Hobbes' discussion of human nature in Chapter 13 of *Leviathan*: see David Hume, *Political Essays*, ed. Knud Haakonssen (Cambridge: Cambridge University Press, 1994), 150–1.

23 Smith, *Lectures on Jurisprudence*, 564.

revolution in economic thought, but by a detailed reconstruction of the past. Instead of reading Smith as part of a grand narrative, with a view to explaining the current ecological crises with reference to his presumed legacy, the discipline of environmental history ought to recognise both the historical context in which an argument was made and the authors' immediate intentions. Understood in these terms, Smith's commentary on mining reveals very intimately the way discussions of certain authors have neglected the precise historical context in which they wrote. It is therefore crucial that environmental history pays a certain amount of attention to this aspect in order to fully recover a more comprehensive picture of how certain historical ideas have been adopted to justify particular contemporary actions.

Conclusion

Through understanding Smith's comments on mining as part of his overarching historical analyses of the failure of mercantilism, this essay has demonstrated that emphasis must be placed on the intellectual context in which he wrote and not the meaning ascribed to his ideas today. In this regard, the type of political economy advocated by him looked to a shift in thinking away from the mercantile logic of the past, towards the advent of commercial society. Thus through his examination of the fall of the Spanish Empire, Smith was able to show how the desire for gold and silver undermined the needs of the development of a modern commercial economic structure. It was the condition of the land and not the minerals beneath it that contributed to a society's development. On this reading, natural extraction was contrasted with agricultural production and its relationship with the development of an urban economy. At the root of Smith's conception of the retrograde order was a view of European history in which agricultural improvement was spurred on by developments in the urban setting. Thus the local rural farmlands became the suppliers on which large towns could draw. Within the present context, Smith's point undercut any estimation of the importance of mining through redirecting the focus away from mineral extraction, on to how investment in agricultural production and the cultivation of the soil aided the emergence of a commercial society. Rather than seeing him as initiating the doctrine of exploiting natural resources, environmental historians ought to reconsider the role of 'history' and 'ideas' when assessing Smith's contribution to debates surrounding the natural world.

Adam Smith's legacy is not one that should be rejected lightly. His contribution to historical and moral debates equalled if not exceeded those of his contemporaries. Questions over his legacy do raise legitimate concerns, particularly over the environment and its relationship to the market. Yet by revisiting his texts, environmental historians can demonstrate inaccuracies in portraying him as the forerunner of deregulation and neo-liberalism. Drawing on the work of scholars such as Skinner, they can also move the discipline towards accepting the problematic

role played by historical intellectual contexts in informing environmental debate. Seeing Smith's commentary on mining in these terms allows historians to appreciate the nuances of his argument. Picking up on this point, environmental history can isolate and interrogate issues of legacy separately from the original texts themselves. Doing so will provide opportunities to better comprehend human understandings of the natural world. It might also stimulate a wider debate about the relationship between intellectual history and the environment.

