Ecological Crisis or Crisis of Knowledge?

Fertilizer, *Sabakh*, and Cotton in Colonial Egypt, 1890s–1910s

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In the history of Egypt's agriculture, the introduction of chemical fertilizers is typically described as a solution to an ecological crisis caused by extractive cotton cultivation. When the British occupied Egypt in 1882, the country had already been exporting its most lucrative cash crop for nearly 80 years. Building on existing technologies and knowledge, the colonial regime expanded Egypt's agricultural infrastructure to increase cotton cultivation further. While the period following the British occupation saw a steady rise in cotton yields, by the early 1900s, cotton growers and colonial officials became increasingly concerned about diminishing outputs. Around 1910, as cotton yields were at an all-time low, contemporary observers warned of an unfolding cotton »disaster« and its dire »repercussions on […] Egypt's financial future«.[1]

Historians have understood the declining cotton yields as a symptom of a broader ecological crisis, unleashed by extractive colonial agriculture. They suggest that chemical fertilizer was increasingly adopted as a »technical solution« used to provide lost plant nutrients and remedy the agricultural-ecological consequences of extractive cotton cultivation and its dire effect on soil fertility during British rule.[2] Ever since, historians of Egypt have assumed that once the problem of soil fertility was resolved and the ecological crisis mitigated, chemical fertilizer was normalized as an agricultural input in Egypt's cotton cultivation. This analysis of chemical fertilizer as a »land-saving technology« used to solve soil problems has reproduced a misleading narrative that reads the *past* adoption of chemical fertilizer through its *contemporary* qualities, where chemical fertilizer is presented as if it was

1 Sékaly, Achille: »Le désastre cotonier de 1909 et ses causes,« in: L'Égypte Contemporaine 2 (1910), p. 226.

2 See Richards, Alan: Egypt's Agricultural Development, 1800–1980. Technical and Social Change, Boulder, CO: Westview Press 1980, p. 126-140; Owen, Roger: Cotton and the Egyptian Economy, 1820–1914. A Study in Trade and Development, Oxford: Clarendon Press 1969, p. 254–259.

congruously embraced upon its introduction as a panacea to soil problems and a proven tool to increase yields.

In fact, during the early 1900s, contemporary observers were mostly confident that a lack of fertility was *not* among the factors contributing to the decrease in cotton output. The 1910 Cotton Commission, which was appointed to investigate the decline in yields, maintained that it »does not believe that soil exhaustion […] plays a major role« in this issue.[3] If soil exhaustion was not perceived as a problem by the contemporaries, how are we to understand the early history of its so-called solution – chemical fertilizer?

Recent studies on fertilizers and manures at the turn of the 20th century have shown how the history of chemical fertilizers' adoption was a complex and frequently contested process. In Germany, France, and the United States, for example, the commercialization and growing usage of fertilizers and manures were intertwined with the rise of agrochemical science, financial networks, and the state backing of those.[4] Furthermore, the understanding of fertilizers and manure in relation to their ecological and social environments was location-specific and constantly in flux.[5] Despite these recent developments, most fertilizer histories are strictly focused on North America and Western Europe, regardless of their approach or specific interest.[6]

This paper builds on the aforementioned works and expands this line of inquiry to the Middle East by examining the early career of chemical fertilizer in Egypt.[7] It studies how contemporary observers perceived its interaction and relations with the ecological, technological, and commercial environments in which they were situated. It first describes Egypt's agricultural transformation at the turn of the 20th century. The following section examines trade, usage, and knowledge production related to fertilizers and manure. Against this backdrop, the third section discusses the

3 Ministere de l'interieur: Rapport General de la Commission du Cotton 1910, Le Caire: Imprimerie Nationale 1910, p. 13.

4 See Uekötter Frank: Die Wahrheit ist auf dem Feld. Eine Wissensgeschichte der deutschen Landwirtschaft, Göttingen: Vandenhoeck & Ruprecht 2010, p. 146–169; Frens-String, Joshua: »Natural Partners. Chilean Nitrates and the Rise of Intensive Agriculture in the US South, 1900–1945«, in: Agricultural History 97 (2023), p. 48–83; Herment, Laurent: Le cultivateur et l'engrais. Une histoire de la chimisation de l'agriculture, Tours: Presses Universitaires François-Rabelais 2024.

5 For example, Treitel, Corinna: Eating Nature in Modern Germany. Food, Agriculture and Environment, c.1870 to 2000, Cambridge, MA: Cambridge University Press 2017, p. 148–188.

6 See Strotmann, Christine/Herment, Laurent/Page, Arnaud: »Fertilisers in the Long 19th Century and Beyond. Usage, Commercialisation and Production (c 1800–1939)«, in: Jahrbuch für Wirtschaftsgeschichte 62 (2021), p. 1–18.

7 A region that suffers from a lack of research on agricultural science. See for example, Anderson, Joe: »The Growing Power of Agricultural Science«, in: Jeannie Whayne (ed.), The Oxford Handbook of Agricultural History, Oxford: Oxford University Press 2024.

work of the Cotton Commission established to study the decline in cotton yields and shows that fertilizer was not perceived as a solution to a problem that did not exist.

Egypt's Cotton Agriculture

When chemical fertilizers first arrived in commercial quantities in Egypt in 1900, the country was undergoing a major agricultural transformation. The British Empire occupied Egypt in 1882 to secure debt repayments to European bankers, who financed the expansion of cotton cultivation under Khedive Isma'il (1863–1879). To that end, the colonial regime worked to maintain the existing agricultural infrastructure of cotton cultivation – Egypt's principal cash crop – and develop it further by introducing new technological, legal, and financial mechanisms. During the British occupation, a surge in the construction of new canals and dams, and especially the establishment of the Aswan Dam in 1902, further expanded not only the year-round supply of water but also the British claims to political sovereignty and scientific expertise.[8] This resulted in a gradual transition from basin irrigation, based on the recurring floods of the Nile River, into a perennial water supply system. By 1912, a canal network of nearly 15.000 kilometers delivered water to almost 4,1 million feddans.[9] Additionally, the British expanded the existing network of agricultural transportation. In the last decade of the 19th century, light railways, which connected to the trunk lines of the state railways, were established, in addition to agricultural roads that had stretched over 2.500 kilometers in the Delta region.[10]

Simultaneously, newly introduced reforms in land ownership and property laws were designed to resolve the problem of peasant debts.[11] The British reforms were mostly unsuccessful and increased the economic gap between Egypt's peasant population – the vast majority of the rural population – and the large landowners. This manifested in rising peasant debt and changing land ownership patterns, which were consolidated further towards large landowners.[12] The worsened »financial position of the smallholders« led them to change the crop rotation system from a three-

8 See Derr, Jennifer: The Lived Nile. Environment, Disease, and Material Colonial Economy in Egypt, Stanford, CA: Stanford University Press 2019, p. 15–43.

9 See A. Richards: Egypt's Agricultural Development, p. 87-92. A feddan is a land measurement unit, equivalent to roughly one acre.

10 See Jakes, Aaron: »The Scales of Public Utility. Agricultural Roads and State Space in the Era of the British Occupation«, in: Marilyn Booth/Anthony Gorman (ed.), The Long 1890s in Egypt: Colonial Quiescence, Subterranean Resistance, Edinburgh: Edinburgh University Press 2014, p. 72–73.

11 See Jakes, Aaron: Egypt's Occupation. Colonial Economism and the Crises of Capitalism, Stanford, CA: Stanford University Press 2020, p. 32–83.

12 See ibid., p. 239–241.

year to a two-year system – which by 1908 was practiced on 57 percent of the cultivated area.[13] Traditionally, the three agricultural seasons followed the temporality of the flood. In winter, *shitawi* crops like wheat, barley, beans, and clover would be planted, later to be followed by *sayfi* (summer) crops like cotton or sugar cane. During the *nili* (flood) season, the land would stay fallow or be planted with maize or rice.[14] The transition to a two-year crop rotation system, which meant fewer fallow months, was criticized by contemporary observers due to its potential negative impact on soil fertility. However, as we shall see, this change was not understood to have a direct impact on the dwindling cotton output.

The expansion of Egypt's agricultural infrastructure, and in particular the transition to perennial irrigation, resulted in an overall increase in agricultural output during the 1880s–1890s. At the same time, the agricultural changes brought up new ecological issues. Historians of Egypt's agriculture have echoed the growing contemporary concerns about the effects of insufficient drainage on cotton crops, in addition to the more frequent outbreaks of cotton pests and a deterioration in seed purity, all caused by the expansion of cotton cultivation under British colonial rule.[15] An overlooked complementary consequence is the effect of the abovementioned changes on fertilizer knowledge and its usages in early 20th century Egypt.

Fertilizer Knowledge and Uses

The transformation of Egypt's agricultural landscape and expansion of cotton cultivation also shaped knowledge about fertilizers and manures and affected their usage patterns. In fact, knowledge on these agricultural inputs was produced, circulated, and popularized in Arabic before the British rule and at least as early as the 1870s. In addition to the daily newspaper *al-Ahram*, which mentioned scientific and economic fertilizer ventures,[16] *al-Muqtataf*, a popular science periodical, publicized knowledge about scientific agriculture and promoted chemistry as a framework to study the natural world as well as a practical tool that could benefit medicine, industry, and agriculture.[17] Around the turn of the 20th century, two main types of fertilizers were discussed. The first was »natural« fertilizer (سماد طبيعي), a collective name for fertilizers and manures originating from animals and plants, such as *sabakh baladi* (سباخ بلدي), which referred to animal dung or farmyard manure, and *sabakh kufri*

13 A. Richards: Egypt's Agricultural Development, p. 87-92.

14 R. Owen: Cotton and the Egyptian Economy, p. 253, p. 258.

15 For example, Goldberg, Ellis: Trade, Reputation, and Child Labor in Twentieth Century Egypt, New York, NY: Palgrave Macmillan 2004, p. 33–62.

16 For example, »sabakh jadid«, in: *al-Ahram*, 02.07.1881, p. 1.

17 See »fadl al-kimiya«, in: *al-Muqtataf*, 01.08.1883, p. 23; »al-kimiya al-zira'iya«, in: *al-Muqtataf*, 01.10.1884, p. 28.

(سباخ كفري), which was used to name organic materials found at ancient settlements and heaps of waste outside contemporary villages and urban centers.[18] The second type was chemical fertilizer (سماد كيماوي), which referred to fertilizer derived from mineral resources.[19] The attention directed to fertilizers and manures stems from *al-Muqtataf*'s editors' general interest in translating and disseminating knowledge about ›modern‹ science and technology during this period.[20]

The growing interest in fertilizers and manures also reflects the changing patterns of their circulation and usage in Egypt under the British colonial occupation. As cotton cultivation expanded and transportation infrastructure developed, the trade in *sabakh kufri* intensified. Simultaneously, the expansion of archeological excavations around the country, where *sabakh* originated, further increased the trade as it was used as a currency to pay for wage labor.[21] An article in *al-Ahram* portrayed in detail how heaps of waste were cleared and transported on the new agricultural railway lines in Fuyum in 1903.[22] Observing that »the proximity of manures to villages [...] exert[s] a strong influence on rents«[23] and witnessing the increasing movement of *sabakh kufri*, British colonial officials and agricultural experts became increasingly alarmed about the scarcity of fertilization materials.[24]

Concerns about the extinction of naturally occurring fertilization materials caused by the expansion of intensive agriculture were also shared by contemporaries in Europe.[25] In Egypt, this notion was especially pronounced in the writings of George Foaden, the leading scientific authority on fertilizers and manures around the 1900s.[26] Foaden argued that the intensification of cotton cultivation necessitated a greater application of plant nutrients to the soil. While he worried that »far from sufficient« quantities of manures were available in Egypt, he did not suggest replacing it with the recently imported chemical fertilizer: »[It is] more practical to employ stable or green manures as the basis of manuring in Egypt and

18 See »sabakh kufri«, in: *al-Muqtataf*, 01.02.1906, p. 164.

19 Also sometimes referred to as artificial fertilizer (سماد صناعي).

20 See Elshakry, Marwa: Reading Darwin in Arabic, 1860–1950, Chicago, IL: University of Chicago Press 2016.

21 See Doyon, Wendy: Empire of Dust. Egyptian Archeology and Archeological labor in Nineteenth-Century Egypt. Unpublished Dissertation, Philadelphia 2021, p. 164–226.

22 See »as-sabakh waal-zira'a«, in: *al-Ahram*, 05.04.1903, p. 10.

23 Willcocks William: Egyptian Irrigation, London: Spon 1913, p. 801.

24 See Egypt. No. 1 (1904), Reports by His Majesty's Agent in 1903 (FO 633/73, The National Archives, London), p. 69.

25 See Page, Arnaud: »›The Greatest Victory which the Chemist had Won in the Fight (...) Against Nature‹. Nitrogenous Fertilizers in Great Britain and the British Empire, 1910s–1950s«, in: History of Science 54 (2016), p. 383–398.

26 See Mackenzie, W. C./Foaden, George: Manures in Egypt and Soil Exhaustion, Cairo: National Printing Office 1896; Foaden, George/Fletcher, F.: Text-Book of Egyptian Agriculture, Cairo: National Printing Department 1908.

to supplement these by the use of [chemical fertilizers].«[27] Throughout his writings, Foaden remained consistent in his claim on the unique position of manure in cotton growing in relation to the supplementary role of chemical fertilizer, a newly introduced technology in Egypt.[28]

Chemical fertilizer was first imported by the Khedivial Agricultural Society (KAS) in 1900. Established by the country's largest landowners and representatives of foreign companies in 1898, the KAS aimed to utilize scientific agriculture for cotton cultivation, and in the process, lay claim to Egypt's agricultural »modernization«.[29] As part of these efforts, and with partial financial assistance from the British colonial government, chemical fertilizer imports grew gradually from 2.152 tons in 1902 to 23.119 tons in 1907.[30] These were mostly mineral-based nitrogenous fertilizers, originating from Chile. In 1910, for example, soda nitrate, also known as ›Chilean Nitrate‹, accounted for roughly 86 percent of total imports. The other two imported chemical fertilizers were superphosphates (9 %) and ammonium sulfate (5 %).[31] In that same year, the 35.558 tons of imported chemical fertilizer were used on roughly 5 percent of the overall cultivated area.[32] Contemporary observers noted that chemical fertilizer was adopted rapidly in wheat cultivation. At the same time, its use in cotton growing remained negligible: in the 1900s, it was mainly used on wheat (85 %), cotton (10 %), and maize (5 %).[33]

As a newly introduced technology in Egypt, the initially contested adoption of chemical fertilizer in cotton was also reflected in the popular scientific media. While some articles in *al-Muqtataf* emphasized chemical fertilizers' beneficial qualities for cotton growing, others contended that fertilization of cotton had not yet proven economically viable.[34] One article in *al-Ahram* even went on to argue that chemical fertilizer had »an extremely negative effect on cotton« and the soil and its usage should be prevented.[35] Many articles also reproduced Foaden's claim on the supplementary role of chemical fertilizer, arguing that manure or *sabakh* was superior.[36]

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27 Foaden, George: Notes on Egyptian Agriculture, Washington: Government Printing Office 1904, p. 29.

28 See ibid.

29 See Abaza, Fu'ad: »al-amir kamal ad-din al-hussain fi al-jam'iyya al-malakiyya«, in: *al-Filaha* 12 (1932), p. 393–395.

30 See Archivo Nacional Historical, Santiago, CLAN, CNCCH, Vol. 324, Egypt: Propaganda Activities, 1910–1930, p. 6. I would like to thank Joshua Frens-String for providing me access to this source.

31 See ibid., p. 7.

32 See Schanz Moritz: Cotton in Egypt and the Anglo-Egyptian Sudan, Manchester: Taylor, Garnett, Evans & Co. 1913, p. 36.

33 See Foaden/Fletcher: Text-Book of Egyptian Agriculture, p. 289.

34 See »khisb at-turba«, in: *al-Muqtataf*, 01.01.1906, p. 75.

35 »Zira'aat al-kutn fi afrikiyya«, in: *al-Ahram*, 03.07.1911, p. 1.

36 For example, »as-samad al-kimawi waal-kutn«, in: *al-Muqtataf*, 01.02.1902, p. 176.

Others criticized not only the use of chemical fertilizers in itself, but also agrochemistry as the leading approach for working the soil.[37]

As cotton cultivation continued to expand, some feared a potential shortage of fertilization materials and warned of declining quantities of *sabakh kufri*. The British government even attributed the overall increase in chemical fertilizer use to the diminishing quantities of *sabakh*, in addition to the propaganda work of the KAS.[38] Others, however, maintained that due to the decrease in the number of animals replaced by steam-powered technologies, farmers turned to chemical fertilizer at the expense of animal manure.[39] In any case, chemical fertilizer was not perceived as a replacement for local manuring technologies, nor was it described as a solution to soil exhaustion. Furthermore, as the public and expert discussion above illustrates, its effect on cotton growing and soils remained highly contested.

Soil Crisis or a Crisis of Knowledge?

As the country spiraled into an economic crisis in 1907 – triggered by financial speculation fueled by the growing agricultural expansion – some had already been pointing to a decline in cotton yields for several years.[40] The average yield of kantars of cotton per feddan pointed to a slow but steady decrease in cotton yields per feddan compared to the previous decade.[41] From 5,41 kantars per feddan in 1986–1899 and 4,93 in 1900–1903 to 4,42 in 1904–1907. After a limited recovery in 1908, cotton yields continued to decline, measuring at 4,12 kantars per feddan in 1909, and at 3,13 in 1910, an all-time negative record.[42] To address the unfolding ›cotton disaster‹, deemed especially urgent due to the precarious financial position of cotton growers, a scientific commission was established to investigate the ecological and agricultural causes behind the fall in cotton output. The 1910 Cotton Commission was composed of government officials, representatives of private enterprises, and experts from the KAS.[43] Despite being a standard reference for historians to explain the ecological crisis that gave way to the decline in cotton yields, it is striking how the Commission's final report conveys mostly uncertainty. Rather than as a scientific study that offered assurance about the role of agro-ecological factors in the cotton

37 See »al-mikrubat fi al-zira'aa«, in: *al-Muqtataf*, 01.07.1898, p. 539.

38 See Egypt. No. 1 (1906), Reports by His Majesty's Agent in 1905 (FO 633/75, TNA), p. 23.

39 See »tasmid al-kutn«, in: *al-Muqtataf*, 01.11.1910, p. 1104.

40 See Balls, Lawrence: »Some Applications of Research to the Cotton Industry«, in: Journal of the Royal Society of Arts 66 (1918), p. 396.

41 Kantar is a weight unit for measuring cotton.

42 See E. Goldberg: Trade, Reputation, and Child Labor, p. 58–59.

43 See Ministere de l'interieur: Rapport General.

disaster, this report can also be read as an informed speculation on the reasons behind the decline in cotton yields.

In the report, the three lines of inquiry into the role of irrigation, pests, and seed purity, which were established in the previous years, were linked to other hypotheses and examined under chapters dealing with irrigation, soil, climate, the cotton plant, and pests. Discussing soil-related issues, the commission established that the change in crop rotation had not led to soil exhaustion since the decline in cotton yields could be seen both on plantations that practiced two-year rotations and three-year rotations. Furthermore, the commission stated that it could not have been the lack of manure or *sabakh* that affected the decline in crops. In the context of the contested discussion on the role of fertilizers and manure in cotton growing presented earlier, the commission maintained that according to recent experiments »cotton yields are not always related to the quantity or quality of manure applied« and concluded that »the lack of manure cannot be seen as an appreciable cause of yield loss«.[44] A soil fertility problem, according to the Commission, was not proven to affect the decline in cotton yields in the early 1900s.

When discussing the cotton plant, the report devoted a short subchapter to chemical fertilizers, which arrived at a different outcome. The report warned of the diminishing quantities of manure and *sabakh*, pointing to the increasing imports of chemical fertilizers as a positive measure to overcome it. Crucially, it did not mention an overall decline in soil fertility or its exhaustion as a factor contributing to the decline in cotton output. At this point, the report stressed the urgent need for further research on the application of fertilizers and lamented the current state of knowledge on this topic, highlighting the »extraordinary lack of data« on fertilization issues.[45] According to the report, the essential knowledge regarding the economical use of fertilizers could only be attained by multi-local experimentation and »by setting up farm schools and testing stations«.[46]

The argument concerning the poor state of contemporary agricultural scientific knowledge is a recurring theme throughout the report: »each time the Commission tried to determine the exact nature of the factors behind the decline [in yields], it was hindered by the almost complete absence of studies on the subject. Given our current state of knowledge, it is impossible to envision a solution to our agricultural problems.«[47] With the last sentence, the commission signposted towards its recommendations, mainly arguing for expanding the agricultural scientific infrastructure of the country. This appeal was later addressed as agricultural schools,

44 Ibid., p. 13–14.
45 Ibid., p. 21–22.
46 Ibid., p. 22.
47 Ibid., p. 28.

demonstration plots, and experimental stations were established under a newly formed Agricultural Department in 1911.

While the first part of the report confidently asserts that soil fertility problems caused by a lack of manure or a change in crop rotation did not affect yield decline, the second part reproduces the narrative of dwindling organic manure sources to argue for the adoption of chemical fertilizer. The different voices within the same report might be explained by the fact that it was written by two sub-groups working under the Cotton Commission. In any case, the call to expand Egypt's agricultural scientific infrastructure corresponded to the need to generate practical knowledge on the economic fertilization of cotton, a major issue of importance to farmers, growers, and chemical fertilizer merchants. As members of the KAS were also part of the 1910 Cotton Commission, the call to expand the scientific infrastructure can also hint at the commercial interest in importing fertilizers and the need to make its effect scientifically and economically comprehensible with local conditions rather than on a soil-related ecological crisis.

Conclusion

By historicizing the early career of chemical fertilizers in Egypt and clarifying their role in the cotton disaster of the 1900s, this paper has shown how the initial adoption of an agricultural input was a contested process, which was shaped by local circumstances. Studying chemical fertilizer through the perspective of government officials, agricultural experts, and popular science writers revealed its entanglements and relations in ecological, technological, and commercial environments. For them, chemical fertilizer and *sabakh kufri* were multifaceted objects – a technology, a commodity, and an object of science.

As an agricultural technology, chemical fertilizer has always been discussed by agriculturalists, scientists, and policymakers in relation to earlier manuring technologies like *sabakh kufri* and their economic role in cultivation. As a commodity, the trade in *sabakh kufri* and chemical fertilizer was shaped by their usage potential as an agricultural technology. As an object of science, knowledge about fertilizer and manure was produced to determine their effect on soils and cotton. The contested knowledge about their potential effects also shaped their usage and trade trajectories. Against this context, the work of the Cotton Commission showed that due to its contested usage, potential chemical fertilizer was not perceived as a solution to soil problems, nor were such problems understood to cause the cotton disaster.

If chemical fertilizer was not understood as a solution to a problem that did not exist, how can we understand the way it first came into use? This paper has suggested several potential answers: the early adoption of chemical fertilizers was contingent upon the agricultural-ecological changes that Egypt's cotton cultivation landscape

underwent. At the same time, it was shaped by commercial interests and scientific motivations and was characterized by contestations and uncertainties. In any case, looking into the origins of chemical fertilizers‹ career in Egypt proves even more crucial in light of Egypt's past and present massive reliance on it. During the first half of the 20th century, chemical fertilizer imports increased more than tenfold, reaching around 250.000 tons annually in the years preceding World War II.[48] After the war, consumption doubled with the establishment of a local fertilizer industry and continued to grow ever since. Nowadays, Egypt is among the world's largest consumers of nitrogenous fertilizers.[49] Understanding the historical roots of Egypt's century-long reliance on chemical fertilizer past might help narrate a new story about the critical dependence of our present-day agro-food systems on agrochemicals.

48 See Imperial Mineral Resources Bureau: The Mineral Industry of the British Empire and Foreign Countries: Statistical Summary, London: His Majesty's Stationery Office [various years].

49 See Barnes, Jessica: Staple Security. Bread and Wheat in Egypt, Durham, NC: Duke University Press 2022, p. 247.