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Nightsoil and the 'Great Divergence': human waste, the urban economy, and economic productivity, 1500–1900

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Abstract

The use of nightsoil, a Victorian euphemism for human faeces and urine, has for some time been recognized as an important feature of Chinese and Japanese agricultural practice. The importance of the work of nightsoil men and women in early modern and modern cities in other parts of the world has not been the subject of much attention, however, nor has the significance of the differential use of human waste. This article explores the varied ways in which nightsoil men and women organized their work in cities around the world in the period from 1500 to 1900. It also examines the ways in which East Asian and South Asian conservancy systems and the consequent development of markets in human manure contributed materially to Asian advantages in agriculture, sanitation, and textile production. European urban authorities, reformers, and scientists initially responded to this challenge with similar efforts to conserve human waste and use it in farming, but these efforts remained small-scale, and in the nineteenth century Europeans turned to chemically synthesized fertilizers.

Keywords conservation, fertilizer, human waste, nightsoil, sanitation

Some time ago Kenneth Pomeranz challenged historians to bring to bear the findings of social history upon the emerging discipline of world history.[1] This has not proven an easy task. The former takes as its subject matter such focused topics as the histories of daily life (including work) and the operation of small-scale institutions such as the family or village, thereby narrowing the historian's field of vision in ways which make larger comparisons difficult. World history as a discipline, by contrast, expresses the promise of 'big history', romping across sweeping vistas of time and space, engaging in broad regional comparisons, and analysing processes of cross-cultural interaction in ways which have sometimes unnerved traditional political or social historians.

1 Kenneth Pomeranz, 'Social history and world history: from daily life to patterns of change', *Journal of World History*, 18,1, 2007, pp. 69–98.

The history of workers on the margins of the world economy, however, provides one vantage point from which to take up Pomeranz's challenge. This essay focuses on one type of marginal worker: men (and women) who collected and sold human faeces and urine, what is often termed, in a Victorian euphemism, 'nightsoil'. In every region of the world, sweepers, scavengers, dustmen, and nightsoil men and women exploited a narrow niche in the economies of early modern cities, amassing, sifting, and often selling the wastes produced by their fellow city-dwellers. Thus the sweepers of pre-colonial Delhi or Paris's *boueurs* or Beijing's nightsoil men offer scholars an opportunity to make the kinds of comparisons central to understanding differential economic and social development in Asia and Europe.

But, as Pomeranz points out, such comparisons often provide conclusions of a lower order, interesting though they may be. More meaningful are histories of large-scale social organizations and groups (such as state–society relations, class formations, race relations) or the history of social movements and 'deliberate attempts to cause social change, whether from the top down or the bottom up'.[2] The workers most often found in this shadowy economy rarely effected social change through sustained and organized activity or public influence. Nonetheless, in addition to opening up a window into the lives and work of one group of marginalized – though not necessarily impoverished – labourers, study of early modern waste-removal regimes also provides critical insights into features of early modern agricultural and manufacturing processes with global significance. The differential use made of human wastes around the world shaped the fortunes of early modern cities and had a major impact on the agriculture of areas surrounding those cities. The labour of nightsoil workers thus played a critical, though often ignored, role in the comparative economic trajectories of Europe and Asia from 1500 to the early twentieth century.

In particular, the conservation of human waste by nightsoil collectors in Indian, Chinese, and Japanese cities, coupled with the use of human waste as an agricultural resource, contributed materially to both the intensive agriculture of Asian farmers and to the comparative advantage of higher real wages paid to Indian, Chinese, and Japanese artisans before the Industrial Revolution.

Conversely, most European cities failed to develop effective systems for conserving human wastes and employing it as manure, only gradually (and with the Asian example in mind) coming to appreciate the agricultural value of human excrement and urine. In the first half of the nineteenth century, as Europeans sought to respond to the Asian agricultural advantage, scientists and agricultural experts called for greater conservation of human waste and application of human manure to agriculture. Despite recognition of the value of human waste and a variety of efforts to adapt European waste management to the Asian model, ultimately across Europe the determination was made to dispose of rather than conserve urban wastes. European and North American farmers adopted chemically synthesized fertilizers instead of the more labour-intensive systems of nightsoil conservation and application. This development of chemical fertilizers has often featured in historical narratives of the 'Great Divergence' that have characterized the differential trajectories of Asian and European economic fortunes after 1800.

Andre Gunder Frank, however, argued some time ago that 'it was not overall poverty and still less tradition or failure that handicapped Asia in the world economic competition

2 *Ibid*.

relative to Europe around 1800'. Rather, he concluded, 'the competitive handicap of the Asian economies was generated by its previous absolute and relative success in responding to the economic incentives of the long "A" phase expansion that the inflow of American money financed, which lasted through much of the eighteenth century'.[3] The success of the Asian conservancy system, and the emergence of markets for nightsoil among peri-urban agriculturists – even, in China and Japan, farmers some distance from city centres – reflected precisely the kind of early advantage that Frank identifies. It was an advantage widely appreciated by many nineteenth-century European agronomists.

Yet, by the early twentieth century, the use of human waste as fertilizer appeared anachronistic to Europeans increasingly accustomed to new, artificial sources of fertilizer. The Asian model of conservancy no longer carried great appeal for European agronomists or reformers. Instead, the exploitation of human excrement and urine as fertilizer, and the degraded figures of scavengers, nightsoil men, and sweepers in Asia, served as just another indicator of the poverty of traditional methods of Asian agriculture and urban planning, when compared to European alternatives.

Waste disposal in pre-industrial cities

Pre-industrial cities struggled to manage the quantities of waste generated daily by their residents. The early modern city's waste stream included tanning residues, manufacturing by-products, animal droppings and carcasses, ashes and soot, rags, wood scraps, kitchen waste, and rotting vegetables, as well as the faecal matter and urine that city-dwellers produced each day. A complex division of labour within these cities arose to profit from these waste accumulations – turning ashes into detergents, using dog excrement for tanning, amassing animal dung for sale to farmers, sifting trash for discarded metals, glass, or other recyclables, and collecting rags for resale to paper mills.

In European cities, a comparably complex division of labour attended to the disposal of urban wastes. And, as was the case elsewhere in the early modern world, the labourers in these occupations included sanctioned and legally recognized workers as well as workers with a decidedly irregular and sometimes uncertain legal status. In French cities, *chiffonniers*, who operated outside the guild system, traversed the urban landscape with an eye open to the most diverse types of waste: rags destined for the fabrication of paper, chimney soot used to stain cloth, dead cats and dogs for their skins, and the fat of horses to make oils. They also picked up cork, nails, splinters of glass, and bone.[4] In Paris, the city was also crisscrossed by *boueurs*, who loaded tipcarts with kitchen wastes and human and animal excrement, which was largely disposed of by dumping it into the Seine, or in trenches alongside the city walls.[5] The *boueurs*, like *chiffonniers* excluded from the guilds, represented an increasingly bureaucratized effort to police the sanitation of the city of Paris.

3 Andre Gunder Frank, *ReOrient: global economy in the Asian age*, Berkeley, CA: University of California Press, 1998, p. 318.

4 Taxile Delord, Arnould Frémy, and Edmond Texier, 'Paris-gagne-petit', in *Les petits Paris* (nos. 6–10), p. 41, cited in Philippe Perrot, *Fashioning the bourgeoisie: a history of clothing in the nineteenth century*, tr. Richard Bienvenu, Princeton, NJ: Princeton University Press, 1994, p. 211, n. 47.

5 Donald Reid, *Paris sewers and sewermen: realities and representations*, Cambridge, MA: Harvard University Press, 1991, p. 55.

A tax had been raised in 1667 to institute a system for lighting and cleaning the streets. This ordinance required householders to gather kitchen wastes and ordure in baskets or in front of the house to be collected by two workers staffing horse-drawn tumbrils.[6] Except for Easter Sunday, *boueurs* circulated the streets of Paris every day, collecting the debris of city households and businesses. As Paris grew, the number of crews and the size of the tumbrils were increased by decree.[7]

Disposal of the city's cesspools and septic tanks was left to the guild of *vidangeurs*. These workers evacuated septic tanks, well privies, and latrines, most often transporting their waste to designated locations along the Seine for discharge. Because of odours emanating from their work, *vidangeurs* operated solely at night. In 1700 only thirty-six *vidangeurs* claimed the right to practise the trade in Paris.[8] By 1776 this number had not increased, largely because retired soldiers and day labourers offered lower-priced competition than authorized cesspool cleaners,[9] or, as was often the case, subcontracted their labour to authorized guild members.

Despite Parisian laws issued from 1374 onwards calling for households to maintain a latrine and later to build a masonry septic tank in either the basement or garden, as in most other French cities the practice of emptying chamber pots and jettisoning kitchen waste into the street remained commonplace.[10] Sixteenth-century ordinances promulgated in the aftermath of plague outbreaks reinforced requirements that householders construct septic tanks in their buildings. Well into the seventeenth century, however, little systematic effort was made to separate faecal matter from other forms of debris in order to exploit it as manure. Moreover, the bulk of the city's ordure was not discharged into septic tanks. Pierre-Denis Boudriot has estimated that as late as 1780 the inhabitants of Paris annually discharged some 270,000 cubic metres of refuse into city streets, over ten times the amount collected by cesspool cleaners.[11] In France's urban centres, as in most of Europe from the sixteenth century to the eighteenth, ordure was a nuisance and waste, jettisoned into the streets or expelled into well privies or cesspools, which were ultimately either amassed in landfills or as often emptied into nearby rivers.

Before 1800, English cities had similarly varied systems of waste removal. Dustmen, crossing sweepers, scavengers, chimney sweeps, and nightsoil men combined to remove or recycle waste materials that cluttered city streets. Though their role is rarely visible in the public record, it is occasionally possible to catch glimpses of them at work. For example, the investigation of the death of Richard the Raker describes the demise of a cesspool cleaner who drowned after falling into a septic tank in 1326.[12] And the account book of St Bartholomew's

6 Leon Bernard, *The emerging city: Paris in the age of Louis XIV*, Durham, NC: Duke University Press, 1970, p. 203.

7 Pierre-Denis Boudriot, 'Essai sur l'ordure en milieu urbain à l'époque pré-industrielle', *Histoire, économie et société*, 5, 1986, pp. 518–19.

8 Bernard, *The emerging city*, p. 207.

9 Boudriot, 'Essai sur l'ordure', p. 522.

10 *Ibid*., pp. 515–520.

11 *Ibid*., pp. 517, 520. See also here Reid, *Paris sewers*, pp. 10–11.

12 Stephen Halliday, *The great stink of London: Sir Joseph Bazalgette and the cleansing of the Victorian metropolis*, Stroud: Sutton, 1999, p. 119, quoted in Steven Johnson, *The ghost map: the story of London's most terrifying epidemic – and how it changed science, cities, and the modern world*, New York: Riverhead Books, 2006, p. 9.

parish in London from March 1660 to March 1661 listed the following: 10 shillings for 'making clene the pissing place at the south Church dore and along the wall', 4 pence for 'bearing away the Rubbishe', and 4 shillings 'for the Skavenger for the use of the Church'. The account book later identifies this last charge as a scavenger's wages for a year.[13] Scavengers, rakers, dustmen, and nightsoil men – certainly prior to the 1780s and 1790s – appear to have been largely independent workers contracting with building owners and householders to clean cesspools and remove waste.

According to Brian Maidment, however, in his recently published study of London's dustmen, increasing parish intervention on behalf of public health during the latter decades of the eighteenth century resulted in increased organization of the dustmen, who annually purchased licences issued by the parish, which entitled them to remove dirt and kitchen wastes from parish residences. Scavengers were similarly employed by parish authorities, making their rounds in high-wheeled and high-sided carts, scrounging for saleable items.[14] T. L. Busby, in his *Costume of the lower orders of London*, described how the system operated:

> The commissioners of the parishes of the metropolis dispose of the ashes to individuals by yearly contract, which gives the contractors the exclusive right to the dust of the respective parishes. At convenient places the ashes are sifted by which process the bones, rags, nails, etc. are separated, and of course disposed of to the best advantage. The breeze is sold for brick making and manure, and the cinders for heating kilns, the bones to make china and hartshorn, and the rags to the manufacturers of paper. Thus we find every part of that which appears rubbish to the housekeeper, is property of no little value to the Dustman.[15]

According to Maidment, while technically parish employees, dustmen managed to remain 'remarkably free to organize their working practices to suit their own needs'. Until the mid nineteenth century, by which time much waste removal had been municipalized and the dustmen had lost the characteristic independence of the early modern period, these workers cultivated a wide-ranging clientele who paid to have soot, ashes, nightsoil, rags, and other waste removed from their homes or the streets before their residences.[16] These licensed contractors faced competition from many unlicensed dustmen, who defrauded contractors by operating on their own, collecting and recycling waste for their own profit. Dustmen, Maidment makes clear, 'did not necessarily rank among the London poor', as their business required significant capitalization and depended upon the employment of sifters and street collectors, who were indeed at the 'bottom end of the economic scale'.[17]

13 *The account books of the parish of St. Bartholomew exchange in the city of London, 1596–1698*, ed. Edwin Freshfield, London: Rixon and Arnold, 1895, pp. 14, 21.

14 Brian Maidment, *Dusty Bob: a cultural history of dustmen, 1780–1870*, Manchester: Manchester University Press, 2007, p. 15.

15 T. L. Busby, *Costume of the lower orders of London*, London: Baldwin, Craddock, and Joy, 1820, quoted in Maidment, *Dusty Bob*, pp. 16–17.

16 Maidment, *Dusty Bob*, p. 15.

17 *Ibid*., p. 24.

European cities accumulated significant quantities of human waste which might have been put to agricultural use. Indeed other organic fertilizers – seaweed, bonemeal, dredged sea sand, herbage, and other sources of nitrogen – were thus employed. The signal difference, however, between waste-management regimes in European cities and those in Asia, as well as those in pre-Columbian Mesoamerica, remained the limited degree to which the hinterlands of European cities employed human excrement and urine as fertilizers. Additionally, Europeans failed to develop markets for human manure until well into the late eighteenth century.

This fact did not reflect a complete ignorance of the uses of human excrement and urine as fertilizers. Though European travellers encountering the sale and use of human excrement frequently expressed surprise – Bernal Diaz's descriptions of the markets of Tenochtitlan come to mind[18] – the use of human sources of manure were not unknown to early modern Europeans. Dominique La Porte, in fact, argues that 'the experience of waste in sixteenth-century France was an authentic feature of its antique revival'. Sixteenth-century humanists thus commented on Roman practice, evident in Pliny the Elder's *Natural history*, and translated agricultural treatises such as Crescentius of Bologna's *Opus ruralium commodorum* (1532) and Constantine VII Porphyrogenitus' *Geoponica de re rustica selectorem Constantino quidem Caesari* (1543), both of which described methods of employing human excrement as manure.[19] Despite this revival of interest in human fertilizers, however, only a few regions before the eighteenth century put the material to agricultural use.

According to Fernand Braudel, with the exception of the immediate Parisian hinterland, parts of Flanders, the countryside surrounding Valencia, and the asparagus farmers of Saragossa, European agriculturalists rarely took advantage of the accumulation of human waste to improve soil fertility on their farms.[20] Nor, in European cities, did the specialized attention to nightsoil collection and use which characterized Asian cities develop. Instead, much as was the case in Paris, villagers from the surrounding countryside came to the city and collected human faecal material, animal wastes, and kitchen detritus from drainage ditches along main thoroughfares where the city's cesspool cleaners took the liberty of dumping their carts, or from courtyards where householders jettisoned their wastes.[21] This happened despite frequently reiterated ordinances forbidding area farmers from using nightsoil on either vegetable or grain crops, and then only three years after the human excrement had been deposited in trenches designated for this purpose.[22] Thus, before the mid eighteenth century throughout Europe, exploitation of human sources of fertilizer was haphazard and informal rather than systematically carried out, as was the case in many parts of Asia.

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18 Bernal Diaz del Castillo, *The memoirs of Bernal Diaz del Castillo, written by himself, containing a true and full account of the discovery and conquest of Mexico and New Spain*, vol. 1, tr. John Ingram Lockhart, London: J. Hatch and Son, 1844, p. 236.

19 Dominique La Porte, *History of shit*, tr. Nadia Benabid and Rudolphe el-Khoury, Cambridge, MA: MIT Press, 2000, pp. 32–3.

20 Fernand Braudel, *Civilization and capitalism, vol. 1: the structures of everyday life: the limits of the possible*, Berkeley, CA: University of California Press, 1992 (first published in French, 1979), p. 116.

21 François Liger, *Dictionnaire historique et pratique de la voierie, de la construction des fosses d'aisance, latrines, urinoirs, et vidanges*, Paris: J. Baudry, Libraire-Editeur, 1875, pp. 88–90.

22 *Ibid*.

Asian conservancy and nightsoil men

By contrast, to a much greater degree than in European cities, many Asian cities devoted significant effort and substantial manpower to the collection and processing of human excrement and urine. Additionally, in both Japan and China, local and regional markets in nightsoil developed, though the work of nightsoil collection varied significantly depending upon the city and region. Moreover, while the work of Indian scavengers and nightsoil collectors has largely been ignored, and the role of nightsoil in Indian agriculture generally discounted, even there use of human waste as fertilizer proved important. Though nightsoil was one of a number of sources of fertilizer employed across the region – alongside fishmeal, dried sardines, oilcakes made from the residue of soy or rapeseed oil pressings, seaweed, herring cake, canal dredgings, and many other nitrogen sources – the significance of the nightsoil trade to Asian agriculture and to the health of Asian cities cannot be overemphasized. Indeed, even as late as the early twentieth century, one Japanese study estimated that perhaps 36% of the manure nitrogen that was consumed yearly in Japan came from nightsoil.[23] The Chinese example, however, was most often held up by nineteenth-century European reformers as a model for their own farmers and urban residents.

In China, the nightsoil trade flourished from at least the Ming era. In Chinese cities, according to Yong Xue, during 'the late Ming [in Jiangnan] an intensive nightsoil trade arose in the course of rapid urbanization'.[24] Because of the concentration of non-agricultural residents, large cities provided substantial quantities of human fertilizer for sale. Yong Xue observes that in Hangzhou, where it was known as the 'business of golden juice (*jinzhi hang*)', different 'business groups' divided the city into districts and hired collectors to empty and clean chamber pots daily. District boundaries were jealously defended, and prized territories – particularly wealthier urban subdivisions which provided excrement more rich in nutrients – were highly sought after. Interlopers into another group's territory faced the threat of lawsuits.[25]

In Beijing, according to Yamin Xu, early eighteenth-century nightsoil men were scattered throughout the city, without specific territorial claims or organization, each nightsoil man acting as an independent contractor. However, as the city's population grew during the eighteenth century, the number of nightsoil men increased and gangs of transients, men with 'thick arms' (that is, willing to fight), divided city neighbourhoods into nightsoil routes shared by nightsoil men and urine jobbers.[26]

Georges Auguste Morache, a nineteenth-century visitor to Beijing briefly described the nightsoil man's routine. His description suggests that little had changed from the eighteenth century. The nightsoil collector 'generally exercised his trade without demanding a payment',

23 Tsubame Sakuta, *Shimogoe (Nightsoil)*, Tokyo: Yûrindô Shoten, 1914, p. 8, cited in Kajo Tajima, 'The marketing of urban human waste in the Edo/Tokyo metropolitan area: 1600–1935', PhD thesis, Tufts University, 2005, p. 91.

24 Yong Xue, '"Treasure nightsoil as if it were gold": economic and ecological links between urban and rural areas in late imperial Jiangnan', *Late Imperial China*, 26, 1, 2005, p. 43; see also Yong Xue, 'A "fertilizer revolution"? A critical response to Pomeranz's theory of "geographic luck"', *Modern China*, 33, 2, 2007, pp. 195–229.

25 Xue, 'Treasure nightsoil', p. 50.

26 Yamin Xu, 'Policing civility on the streets: encounters with litterbugs, "nightsoil lords", and street corner urinators in republican Beijing', *Twentieth-century China*, 30, 2, 2005, pp. 40–50.

making his rounds 'until his basket was full, then carrying it to a depot where he received his day's earnings'.[27] Nightsoil merchants owned processing centres to which nightsoil men brought the waste. Some of the merchants collected the material themselves, while others merely owned the routes (which could be purchased for between twenty and thirty *taels* of silver) and employed hired labourers to clean the chamber pots of between several dozen and two hundred households.[28] Here as well, wealthier urban districts were particularly coveted, as the nutrient quality of the nightsoil fetched higher prices. Thus in China, beginning at the latest by the sixteenth century, a complex organization of waste removal developed to collect, process, and finally market human waste to farmers eager to purchase this rich source of manure.

Similarly, a lucrative trade emerged in Japan. Sanitation regimes in Edo (modern Tokyo) and Osaka during the Tokugawa period have been studied extensively by Susan Hanley. In Osaka, during the sixteenth century, human manure was collected throughout the city for distribution to nearby farms. Boats sent to Osaka loaded with produce were offloaded and exchanged for nightsoil. This trade was so profitable that complaints by townspeople at the stench were ignored by city magistrates. During the seventeenth century, alongside rising prices of competing fertilizers, primarily fishmeal and oilcake, the price of nightsoil increased as well, and by the eighteenth century could only be purchased with silver.

Unlike the pattern in Chinese cities, in Osaka the right to proceeds from excrement belonged to building owners, though tenants maintained the right to sell their urine. During the Tokugawa period, rights to the faecal matter produced yearly by ten households sold for between two and three *bu* of silver, an amount equivalent to the price of half a year's grain staple for a single adult. Landowners consequently considered the number of tenants and resulting sale of faecal material when establishing rents. During the seventeenth century, the city authorized guilds to handle the collection of faeces, while neighbouring farm villages likewise organized associations to purchase nightsoil from specific city districts. Disputes between competing villages over claims to nightsoil and conflicts between city guilds over territorial boundaries were a feature of the seventeenth- and early eighteenth-century trade in nightsoil. Household urine, by contrast, was collected by urine jobbers, or *shōben nakagainin*, who in 1772 established their own guild, with the right to regulate trade and set prices for urine collections. A neighbouring outcast village, however, also maintained the rights to collect urine deposited in containers strategically located on the public highway. As Susan Hanley notes, by the eighteenth century nightsoil was 'clearly an economic good' with a market-established pricing structure, contested ownership rights, and recognized guilds and associations for distribution and acquisition of the product.[29]

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27 Georges Auguste Morache, *Pékin et ses habitants: étude d'hygiène*, Paris: J.-B. Baillière et fils, 1869, p. 31.

28 *Ibid*., pp. 41–3. The Chinese *tael* was valued at between 5 shillings and 10 pence and 7 shillings. The dollar value of the *tael* was fixed at US$1.48 from 1789 to 1870. See Nicholas Belfield Dennys, William Frederick Mayers, and Charles King, *The treaty ports of China and Japan: a complete guide to the open ports of those countries, together with Peking, Yedo, Hong Kong, and Macao*, London: Trübner and Co., 1867, pp. 333–40; 'Letter from the Secretary of the Treasury in relation to the value of the tael of China', 1 April 1870, in *Executive documents printed by order of the House of Representatives during the second session of the forty-first Congress, 1869–1870*, Washington, DC: Government Printing Office, 1870, Executive Document no. 229.

29 Susan B. Hanley, 'Urban sanitation in preindustrial Japan', *Journal of Interdisciplinary History*, 18, 1, 1987, pp. 1–26.

Edo also rapidly developed a market for urban wastes. Initially, according to Anne Walthall, *daimyo* (feudal lords) contracted with nearby farm villages to remove nightsoil, cultivating relationships with village headmen, who acquired permission to clean latrines in exchange for supplying vegetables and horse fodder.[30] During the seventeenth and early eighteenth century, villagers, usually well-off farmers, provided for the daily needs of the *daimyo* estates or Edo castle, acquiring in return the kitchen wastes and nightsoil. For example, Kasai Gonshirō from Kasai village, east of Edo, towed two boats to the north gate of Edo castle to be loaded with nightsoil for his village.[31] The growing importance of nightsoil collection, however, can be seen in detailed instructions contained in the Keian Edict of 1649 given to peasants on how to collect ash and nightsoil. Agricultural treatises dating from the late seventeenth and early eighteenth century also gave detailed instructions on how to build toilets to best collect faeces, the best times to fertilize the fields, and proper methods for applying nightsoil. These treatises further identified specific quarters where the best nightsoil could be obtained and detailed the kinds of tools and buckets most appropriate for collecting nightsoil.[32]

Gradually, however, the right to collect nightsoil became a commodity which could be bought and sold as well as subcontracted to others. The agricultural manual *Kōka Shunjū* (*Spring and autumn: an agricultural manual*), published in 1707, described how peasants in the nearby castle town of Kanazawa made the transition from bartering for urine to paying cash for the product:

> In the past six or seven years, most of the urban households have come to think straw was not enough as a reward for their urine. Therefore peasants have started to grow more vegetable produce such as daikon radish, turnip, squash, and eggplant to pay for it. This in turn requires larger amounts of fertiliser, thus, every morning farmers harvest the grown vegetables and exchange them for the nightsoil. … Since the rooster year of Hôei [1702], all commoners, regardless of whether they are poor or rich, ask for cash to pay for their nightsoil.[33]

In Edo and other Japanese cities, population increase during the seventeenth century, and the greater densities of the city centres, made it impossible for residents to supply the growing demand for vegetables with their own garden plots. Urban-fringe agriculture then shifted to vegetable production for this market, necessitating greater inputs of fertilizer, of which the growing cities had plenty in the form of human excrement and urine. Various forms of barter and contractual arrangements between suppliers and consumers of nightsoil and vegetables followed.[34]

In the eighteenth century, as nightsoil's value rose, nobles then eschewed customary contracts with peasant clients in exchange for more commercial relationships.[35] Typically *daimyo* annually offered out the rights to collect nightsoil from specific urban districts.

30 Anne Walthall, 'Village networks, *sodai* and the sale of Edo nightsoil', *Monumenta Nipponica*, 43, 3, 1988, pp. 294–6.

31 Kajo Tajima, 'The marketing', p. 72.

32 *Ibid*., pp. 43–49.

33 Zenjirô Watanabe, *Toshi nō nosen no aida: toshi kinkō nōgyōshi-ron (Between urban and rural: a history of urban agriculture in suburban areas)*, Tokyo: Ronshōsha, 1983, p. 282, cited in Kajo Tajima, 'The marketing', p. 70.

34 *Ibid*.

35 Walthall, 'Village networks', pp. 294–6.

Thus in 1742, the Hitotsubashi *daimyo* sold the rights to the estate's nightsoil for the price of 1,500 large white radishes or the price of 2,000 middle-sized radishes, or two *ryo* in gold, whichever the buyer preferred.[36] By the late eighteenth century and early nineteenth it was not unusual for these rights to be subdivided, as was the case when the Oba family, who owned the rights to the Ii estate in Edo, divided the 'cleaning permit' (*shimo-soji-kabu*) among sixteen holders whose rights included not only the ability to form an association to manage nightsoil collections but also the right to trade the rights to others who qualified to purchase a share.[37]

While farming villages and well-off farmers purchased the rights to acquire nightsoil and use it, actual collection of nightsoil often fell to workers who stood lower on the social hierarchy. Villagers who had purchased the right to collect nightsoil often hired others, usually *hinin* (outcasts), to do the dirty work.[38] Edo's *hinin*, though linked frequently to occupations with ancient notions of pollution, also worked in many other capacities related to waste disposal: collecting scrapwood and paper debris for sale to bathhouses, keeping rivers clean, pulling carts, and repairing sandals.[39] The practice of hiring *hinin* to clean toilets paralleled that in French cities, where master *vidangeurs* hired day labourers to do the work of cleaning latrines and cesspools.[40]

In India similarly, the work of sweepers has been most often associated with caste distinction, and scavenging with conceptions of ritual defilement. In one early European description of these arrangements, Peter Mundy, writing in the early seventeenth century, took note of Indian toilets and the workers who cleaned them:

> The hallalcores [*halālkhor*] are a kinde of base, abject and contemned people or cast, most commonlie put to empty houses of office, which goe not with vault as ours only in some place are certen high stepps one by another, on which they sett their feete and ease themselves which is by and by carried away by the Hallalcores, soe that there is seldome any ill savor in their houses of office. … Any man that touches any of them thincks himself polluted, soe vilely are they accounted. Yett, are they in all great mens houses for the uses aforesaid.[41]

Mundy vividly captured both the abjection and the utter necessity of their work. Because of its association with death and organic pollution, scavengers and sweepers have often been considered among the meanest of castes.[42]

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36 Hanley, 'Urban sanitation', pp. 11–12. Two *ryo* amounted to the equivalent in grain crops of two years of an adult's sustenance.

37 Kajo Tajima, 'The marketing', pp. 72–3.

38 Walthall, 'Village networks', pp. 294–6.

39 Gerald Groemer, 'The creation of the Edo outcaste order', *Journal of Japanese Studies*, 27, 2, 2001, pp. 287–8.

40 Dean T. Ferguson, 'Neither master nor laborer: the identity of the unincorporated worker in early modern Lyon', PhD thesis, Purdue University, 1997, p. 151.

41 Peter Mundy, *The travels of Peter Mundy in Europe and Asia, 1608–1667*, vol. 2: *1628–1634*, ed. Sir Richard Carnac Temple, Nendeln, Liechtenstein: Kraus Reprint, Ltd., 1967 (reprint of London: Hakluyt Society, 1914), p. 310.

42 B. N. Srivastava, *Manual scavenging in India: a disgrace to the country*, New Delhi: Ashok Kumar Mital Concept Publishing Company, 1997, pp. 19–20; see also Rama Sharma, *Bhangi, scavenger in Indian society: marginality, identity and politicization of the community*, New Delhi: M. D. Publications, Ltd., 1995, pp. 4–10.

These labourers, not surprisingly, do not feature significantly in the historical record before the colonial period. Vijay Prashad, however, who has written extensively about the struggle by British administrators to regulate these workers during the early years of the Raj, has reconstructed some features of their work during the nineteenth century which may also have earlier parallels. According to Prashad, Shahjahanabad and other cities had permanent sanitation crews, about which very little is known, who were described variously as *Shahi* or *Nawabi Mehtar*, *Kahrub* (to sweep the dust), and *Halalkhor* (to whom all food is lawful).[43] Prashad then observes that,

> Before the reconstruction of Delhi's urban governance by the British, the sweepers worked as employees of *mohallas* (neighbourhoods) rather than as servants of the state. The sweepers belonged to a set of menial castes, mainly dalits, a social fact that brought them the scorn and prejudice of those for whom they cleaned. Nevertheless for many sweepers the relative independence they enjoyed, such as their freedom to work in bands across the cityscape in accord with rules of their own making, was a matter of considerable importance …[44]

The sweepers of Delhi claimed a customary right to clean neighbourhood households. As was common elsewhere in the business of street-sweeping and collecting nightsoil, these workers sought to control neighbourhoods and nightsoil routes. But, unlike Chinese guilds, or Japanese nightsoil men, who fought outright to lay their claims, or managed to establish contractual relations with homeowners, sweepers in Delhi before the 1880s guaranteed their employment through unwritten agreements with other sweepers, who refused to cross neighbourhood boundaries in competition with their fellows. The householders of each *mohalla* provided their sweepers with a daily wage paid in food, as well as monthly dues paid in cash. Sweepers' earnings also included sums of money or payments in food given at ritually significant occasions. They further owned the faeces and urine produced by a neighbourhood. Prashad observes that 'control over this waste was essential, for it provided the sweepers with additional income (including that generated when the sweepers repaired and recycled items deposited in the trash)', when they sold the human waste for fertilizer.[45]

Superiority of East Asian conservancy systems

The implications of Asian systems of conservancy and nightsoil usage are numerous. Indeed, it is quite clear that in Asia the interlocking histories of urban demographic growth and sanitation followed very different trajectories from those pursued in Europe, at least in part because of conservation and use of nightsoil. Susan Hanley has argued that the rapid

43 Vijay Prashad, *Untouchable freedom: a social history of a Dalit community*, New Delhi: Oxford University Press, 2000, pp. xvi–xix.

44 *Ibid*., pp. 4–6.

45 *Ibid*. This practice paralleled that followed in villages across India. Denzil Ibbetson, for example, observed that scavengers in Punjabi villages were paid a customary wage consisting of a fixed share of the village's fields: Denzil Ibbetson, *Panjab castes: being a reprint of the chapter on "The races, castes, and tribes of the Panjab", in The Report on the census of the Panjab published in 1883 by the late Sir Denzil Ibbetson*, K.C.S.I., Lahore: Superintendent, Government Printing, Punjab, 1916, pp. 270–1. A similar system of payment in grain and money operated in South India: see Benedict Hjejle, 'Slavery and agricultural bondage in South India in the nineteenth century', *Scandinavian Economic History Review*, 25, 1–2, 1967, p. 79.

urbanization of Japan during the Tokugawa period (1600–1868) and the higher degree of urban sanitation in early modern Japan resulted from the fact that, unlike most European regions, the Japanese valued human excreta as fertilizer, and had developed systems to rid the cities of their waste with minimal contamination of water supplies. As a result, the water supply system constructed in early seventeenth-century Edo required little renovation in the late nineteenth century, save the replacement of subterranean wooden conduits with iron piping. Studies of Tokyo's water supply carried out in the mid 1870s by R. W. Atkinson, an English chemist, revealed a water supply purer than contemporary London. In 1700 Edo was the largest city in the world, and in 1800 it sustained a population of over one million residents, without a modern water supply or sewage system.

Nor was urban growth in Tokugawa Japan confined to the capital city; with only 3% of the world's population, Japan had over 8% of the world's urban population. In 1800 only London and Paris among European capitals were larger than Kyoto and Osaka. The market for nightsoil, largely collected by Japan's urban outcasts, sustained the intensive peripheral greenbelts which surrounded and fed the cities, but also led to a higher level of sanitation than was characteristic of European cities of the period. Hanley points out that some parts of Japan, even after the Second World War, continued to use nightsoil for fertilizer and to eschew modern sewage systems in many of their cities, leading Westerners to judge them backward. However, the very success of this pre-modern approach made the expensive and wasteful modern toilet and sewage systems unnecessary until well into the twentieth century.[46]

Similar conclusions could be drawn from both Chinese and Indian evidence. Sidney Gamble, for example, described how the sewage system of Beijing, dating to the Ming era, primarily collected drainage and waste water, mostly serving to drain rainwater overflow.[47] The threats to the water supply system were thus diminished by the practice of using human ordure for fertilizer. Moreover, peri-urban agriculture, principally devoted to vegetable and fruit production, sustained a more balanced and nutritious diet among Chinese urbanites than was the case for city residents in early modern Europe. Similarly, in India's cities, water supply systems and waste-removal regimes combined to ensure a ready supply of fertilizer and improved sanitation. Mughal Delhi's canals and subterranean drainage system diverted water from the Jamuna River to evacuate masonry and stone drainage conduits, which remained largely free of the human waste collected and removed by sweepers, leaving the drainage system and the surrounding rivers predominantly clear of human and animal excrement.[48] Here as well the greenbelts which surrounded Indian cities, and which were served by supplies of urban manures, provided the raw materials for the cotton textiles which Indian artisans produced as well as sugar, fruit, and vegetables for urban residents.

Perhaps the most obvious and immediate consequence of Asian conservancy regimes may be observed in the agricultural sector. There is little doubt that East Asian agriculture benefited from careful exploitation of human waste. Historians, however, have frequently judged such conservancy efforts less positively. Fernand Braudel identified the highly

46 Hanley, 'Urban sanitation', pp. 3–5, 26.

47 Sidney D. Gamble, *Peking: a social survey*, New York: George H. Doran, 1921, pp. 120–2.

48 Vijay Prashad, 'The technology of sanitation in colonial Delhi', *Modern Asian Studies*, 35, 1, 2001, p. 120.

labour-intensive practices of accumulating, processing, and applying urban waste as evidence of economic inversion. He argued that,

> In the last resort, the China of the paddy-fields represents the triumph of a peasantry turning in upon itself. Rice-growing was not initially directed towards outlying areas and new land, but became established around the already existing towns, and the mud of the streets that fertilised the first rice fields. So there was a constant coming and going of peasants to collect from the towns the precious fertiliser 'which they pay for with herbs, vinegar or money'.[49]

Chinese peasants, in this characterization, rather than capitalizing their farms with inputs of commercial fertilizers, relied instead on increasingly labour-intensive utilization of bartered nightsoil.

The agricultural use of nightsoil has a long history in China. At least as early as the Yuan dynasty and perhaps earlier, according to Dwight Perkins, nightsoil, along with lime, poultry feathers, and river, pond, and sewer dredgings was employed as fertilizer.[50] However, the development of local and regional trade in human manure appears to have been a late Ming development that only expanded over the later centuries of the Chinese empire. In part this trade derived from the widespread availability of nightsoil produced by China's population, which grew at rates nearly double the expansion of cultivated acreage from the late Ming period to the early twentieth century.[51]

Before the sixteenth century, sources do not indicate a significant commerce in human excrement and urine. Late Ming evidence, however, reveals a burgeoning transport of nightsoil from urban centres to the countryside. The farm manual, *Shenshi nongshu* (*Agricultural manual of Mr Shen*), written by a managerial landlord from Lianchuan in eastern Huzhou prefecture, describes frequent travel to as far away as Hangzhou – a distance of nearly 50 miles – in pursuit of nightsoil, as well as many trips to towns and cities less distant. Hangzhou was particularly favoured because of the high quality of human manure to be found there, a consequence of the city's rich diet.[52] Ordinary peasants probably did not travel as far or as often. Nonetheless, in some parts of the country evidence suggests that individual peasants collected nightsoil (as well as animal waste, mud from ditches, kitchen scraps, fireplace ashes, and animal bones) directly from city residents without facing competition from commercial enterprises. But, with the increase in number of substantial towns in Jiangnan between the sixteenth and nineteenth centuries, peasants often travelled some distance to collect fertilizer, purchasing it from brokers. In this highly commercialized region, by the early eighteenth century nightsoil collecting had become a lucrative business. An imperial agricultural treatise from 1737 described how, 'during the seasons of nightsoil collecting, those boats (farm boats) travel everywhere in cities. They go out with an empty hold, and return fully loaded with nightsoil.'[53]

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49 Fernand Braudel, *Structures of everday life*, p. 159.

50 Dwight Perkins, *Agricultural development in China, 1386–1968*, Chicago, IL: Aldine, 1969, p. 70.

51 *Ibid*.

52 Xue, 'Treasure nightsoil', pp. 44–50.

53 *Ibid*., pp. 54–5.

The historical significance of this trade to the comparative development of Chinese and European agriculture is worth emphasizing. Kenneth Pomeranz has argued that western European and Chinese agricultural regimes faced similar population pressures and ecological constraints in the eighteenth and early nineteenth centuries. China, however, alleviated the effects of worsening person to land ratios by greater utilization of both manure and soybean cake fertilizers, as well as increased multi-cropping and more thorough cultivation.

Pomeranz contends that English agricultural productivity, by contrast changed little between 1750 and 1850, until after England began importing and then synthesizing industrial fertilizers.[54] In fact, as will be described later, in virtually every European nation and in North America, experimental efforts – many self-consciously addressing the East Asian example – were made to establish similar conservancy efforts; in other words, to turn the sewage of Western cities to agricultural use. These efforts coincided with and were eventually superseded by fertilizer imports and finally the industrial production of chemical fertilizers.

Chinese use of fertilizers features prominently in Pomeranz's argument. In China, pigs and humans provided the most important fertilizer sources, with a range of 12,346–19,621 pounds of manure applied per cropped acre compared to 8,820–12,346 pounds for late eighteenth-century Europe. Though Pomeranz acknowledges that comparisons of this sort are 'beset by many uncertainties', Chinese farms probably benefited more from higher-quality manure, applied more often and in greater quantities than was the case in Europe.[55] The critical ingredient of his 'fertilizer revolution' in China – soybean cake imported from Manchuria – was a more costly but less labour-intensive fertilizer source, which contributed to improving the productivity of Chinese farms.[56] Though Pomeranz stresses the importance of soybean cake, the persistent use of human manure in the Yangzi Delta remains worth emphasizing, a fact which Pomeranz's own scholarship supports: bean cake imports equivalent to 325 million pounds provided less than 30% of the fertilizer acquired from human sources. Relying on John L. Buck's calculation that an adult male produced 992 pounds of nightsoil per year, Pomeranz observes that late eighteenth-century Jiangnan, with an approximate population of thirty-one million probably 'provided about nineteen billion pounds of nightsoil prior to dilution or perhaps as much as fifty-seven billion pounds after dilution'.[57] If, as Ming-te Pan estimates, bean cake substituted for between thirty and fifty times the quantity of diluted manure, the amount of nightsoil annually produced in Jiangnan alone would have necessitated the importation of between 1.14 and 1.9 billion pounds of bean cake (far larger quantities than either Pomeranz or his critics contend) to substitute for the use of human manure.[58] Clearly, one of the advantages claimed by Chinese farmers before the mid nineteenth century was that associated with the use of human manure.

54 Kenneth Pomeranz, *The Great Divergence: China, Europe, and the making of the modern world economy*, Princeton, NJ: Princeton University Press, 2000, pp. 14, 216–17.

55 *Ibid*., pp. 303–6.

56 *Ibid*., pp. 98–9.

57 Kenneth Pomeranz, 'Beyond the East–West binary: resituating development paths in the eighteenth-century world', *Journal of Asian Studies*, 61, 2, 2002, p. 584.

58 Ming-te Pan, 'Rural credit market and the peasant economy (1600–1949)', PhD thesis, University of California Irvine, 1994, pp. 36–8, 110–13, quoted in Pomeranz, *Great Divergence*, p. 98.

Indian nightsoil use: a second look

The case for similar advantages accruing to South Asian farmers from the use of nightsoil merits examination, despite the widely repeated belief that application of manure, whether human or animal, was generally not a feature of Indian farming practice. This is in direct contradistinction to Chinese and Japanese practices, which have occasioned frequent comment. Fernand Braudel, for example, acknowledged a 'burst of agricultural activity' associated with Mughal rule, and the importance of commercial cultivation of indigo, sugar cane, cotton, and mulberry trees. But he argued that, in India, 'unlike Japan, it seems, there was no equivalent progress in agricultural techniques. Animals, oxen, and buffalo, played an important role as beasts of burden or as draught animals, but their dried dung was used as fuel, not as fertilizer. For religious reasons, human excrement was not used as manure, as in China.'[59] Interestingly, European farmers' reluctance to use human excrement did not occasion similar objections.

Other historians have credited South Asian peasants with greater awareness of the advantages of manuring, but have likewise concluded that human ordure was rarely utilized in India.[60] In this they have repeated the assertions of nineteenth-century British colonial administrators and agronomists, who frequently juxtaposed the industry and efficiency of East Asian peasants with their Indian counterparts. These critics of Indian agricultural practices ascribed Indian failure to fully utilize animal and human manure to ritual taboos and caste distinctions. William Moore, for example, in his 1891 report on sanitary conditions in India, concluded that 'the weakest point of native agriculture was the deficient use of manure, principally because of the Indians' objection to use human ordure or sewage, an antipathy which has been overcome in many localities, although it still prevails in others'.[61] Unlike their counterparts in China and Japan, Indian farmers were reputed to have refused to exploit the supplies of manure at their disposal.

Moore might have read the report of the Sanitary Administration of the Punjab for 1883 to the Delhi Municipal Committee, which was mirrored in other municipal and district records of the period. As the report complained, 'the most part of the town refuse is appropriated by a comparatively small number of private sweepers, who are entirely independent and irresponsible as to the time and method of their collecting and removing this filth, and who render no service to the town in return for the common property which they appropriate at their pleasure'.[62] In addition, the report objected to scavengers' focus on collecting the more valuable human waste, while neglecting to keep city streets clean. Moreover, city scavengers, on occasion, 'absented themselves for days together', effectively striking against homeowners who did not agree to their demands. The author of the report, before making his recommendations, argued finally that 'The town filth, it seems to me, belongs to the town at large, being contributed by all its inhabitants, and I do not see by

59 Braudel, *Structures of everyday life*, p. 157.

60 Tapan Raychaudhuri, 'The mid-eighteenth-century background', in Dharma Kumar, ed., *The Cambridge economic history of India, vol. 2: c. 1757–1970*, Cambridge: Cambridge University Press, 1983, p. 16.

61 William Moore, 'Sanitary progress in India', *Transactions of the Seventh International Congress of Hygiene and Demography*, London, 10 August 1891, vol. 11: *Indian hygiene and demography*, London: Eyre and Spottiswoode, 1892, p. 20.

62 *Report on the sanitary administration of the Punjab for the year 1883*, Lahore: Central Jail Press, 1884, pp. 90–1.

what right a few people can claim it as their privilege to appropriate this common property and possess themselves of it without rendering any service in return.'[63]

It is worth remembering that the common property so much in demand here was the faeces and urine of Delhi residents, collected by the city's 'independent sweepers', and sold as manure to area farmers. Indeed, this source of revenue was precisely what the author hoped to secure for the municipal government. The report's recommendation was that the Delhi Municipal Committee systematically collect and store 'house sweepings, night-soil, latrine ordure, street filth, slaughter-house offals, carcasses of dead animals, etc.', a system of conservancy that the author observed would be entirely self-supporting, if properly enforced.[64] Enforcement implied breaking the monopoly of the city's independent sweepers. The evidence from nineteenth-century India, which is duplicated in reports from around the country, belies the commonly heard assertion that Indian farmers did not use human waste as a fertilizer.

While in some cities – Calcutta most notably – conservation of human excrement and urine may not have been practised, in many parts of India, nightsoil was commonly used as a fertilizer. In Allahabad, George W. Johnson confirmed the limited use of cow dung as manure owing to its value as a fuel source. However, he continued, 'any kind of filth or rubbish is used and is carried out upon the land in baskets borne on the heads of labourers'. He also noted that in the vicinity of Bangalore, nightsoil was the preferred manure for both sugar cane and grain crops. And, in the immediate environs of Seringapatanam, ashes and ordure from the city were transported to the fields in sacks carried by bullocks, one indication that, while scavengers may have been despised, the profits to be made from the sale of nightsoil and the capital invested in the trade were not insignificant.[65] Thomas Gillham Hewlett, Sanitary Commissioner for Bombay, reported that, in the Deccan, 'night-soil has long been utilized under the name of "*sonkhund*" golden manure'. Hewlett also discounted Hindu misgivings about using the substance as fertilizer, recalling a Hindu gardener's statement that 'he was well aware of the value of nightsoil as a fertilizing agent, and that he had in former years employed men to collect it in the gullies of Native Town, and had used it with success in his market garden'.[66]

In a circular dated 10 September 1873, the Superintendents of Jails in the Punjab were asked to experiment with the use of '*poudrette*' (desiccated nightsoil) and to report to the Government of India the full results of these experiments. Attached to this circular was a *précis* recording the practice of nightsoil usage elsewhere in India. Hewlett's observation about the Deccan was repeated here, as were observations of other areas in India where nightsoil was employed. The Chief Commissioner of Mysore reported that nightsoil 'is very generally used, mixed with other manure, by numerous gardeners about Bangalore, and is well known and highly appreciated as a valuable fertiliser'.[67] Similarly, the Commissioner in Sind reported that, while Muslims

63 *Ibid*.

64 *Ibid*.

65 George W. Johnson, 'On the agriculture of Hindostan', *Simmonds Colonial Magazine and Foreign Miscellany*, 2, May–August 1844, pp. 231–2.

66 Thomas Gillham Hewlett, cited in *Report on measures adopted for sanitary improvements in India from June 1870 to June 1871*, London: George Edward Eyre and William Spottiswoode, 1871, p. 39.

67 Circular no. 30-3659, 10 September 1873, in *The Punjab record or reference book for civil officers*, vol. 13, London: W. E. Ball, 1873, p. 27.

(who made up the bulk of the 'cultivating class' in Sind) did not use nightsoil, most of the regions' gardeners, 'who are almost invariably *Banias* [Hindu merchant-farmers], are well acquainted with its use', employing it principally on *bhang* (marijuana), tobacco, saffron, and other cash crops.[68] From Oudh, the Superintendent of the Department of Science reported that 'nightsoil has been used by native cultivators from time immemorial with immense benefit to their crops'.[69] At least by the nineteenth century, therefore, agriculturalists in many parts of the subcontinent were using nightsoil as a fertilizer.

Evidence from the Mughal era also suggests that farmers in the urban hinterlands were not as antagonistic to the use of urban wastes as once supposed. In his study of Shahjahanabad during the seventeenth and eighteenth centuries, Stephen P. Blake noted as an aside that 'the enormous supply of manure and the ready market made the cultivation of fruits and vegetables in gardens near the wall extremely profitable'.[70] Unfortunately, he did not pursue this insight. Vijay Prashad's study of colonial Delhi suggests that greater importance should be credited to the use of human manure in seventeenth-century Delhi. He notes that, under the Mughals, Delhi residents threw their kitchen wastes into the street while excrement and urine were collected in latrines that drained into receptacles accessible to city sweepers and scavengers. Street sweepers then shoved the household wastes into jute sacks which were placed on bullock carts to be dumped over the city wall. Cartloads of nightsoil and urine were also collected and disposed of in this manner. The garbage heap that accumulated outside the city walls was trenched and the composted waste transported to nearby villages, where farmers used it as fertilizer.[71] The 45,000 villages which surrounded Shah Jahan's Delhi were well provided for by this fertilizer, with sugar cane fields absorbing 11 tons of manure per acre and melon fields some 150 bullock carts per acre.[72]

Human excrement, costly to acquire, transport, and spread on the fields probably benefited few subsistence farmers and was used primarily by such clearly commercial enterprises as sugar cane and melon farming. Fruit production and market gardening may have accounted for more than 5% of cultivated acreage in northern India, and areas surrounding Mughal cities extending between five and ten miles were devoted to intensive cultivation of market gardens and fruit orchards, as well as to grain crops, which were frequently fertile enough to sustain double cropping. The main reason for the superior productivity of these fields may be attributed to market gardeners' exploitation of both urban wastes and animal dung, which was not used in this instance for fuel.[73] While the tendency to use cow dung as fuel may have reduced the availability of animal fertilizers, the contention that ritual defilement associated with handling human faeces ultimately led to

68 *Punjab record*, p. 29; On the *banias*, see David Cheesman, *Landlord power and rural indebtedness in colonial Sind, 1865–1901*, Richmond: Curzon Press, 1997, pp. 163–4.

69 *Punjab record*, p. 29.

70 Stephen P. Blake, 'The urban economy in premodern Muslim India: Shahjahanabad, 1639–1739', *Modern Asian Studies*, 21, 3, 1987, p. 467.

71 Prashad, 'Technology of sanitation', pp. 113–55.

72 *Ibid.*, p. 137.

73 C. A. Bayly, *Rulers, townsmen, and bazaars: north Indian society in the age of British expansion, 1770–1870*, Cambridge: Cambridge University Press, 1983; Prashad, 'Technology of sanitation', pp. 43, 101.

Indian farmers neglecting this nutrient rich manure should at least be called into question. Just as in China and Japan, human waste served as an important fertilizer for the fields of vegetable and fruit growers, particularly those located in the hinterlands of large cities.

In no small part, the agricultural advantages which Indian peasants claimed over early modern European agriculturists resulted from the use of human and vegetable waste transported to fields near urban centres, a practice which was only belatedly adopted in Europe.[74] This advantage, as Indian historians have been claiming for some time, contributed to the comparatively higher real wages of Mughal India. Since the 1970s, Indian scholars have questioned the degree to which Indian wages and standards of living lagged behind European conditions before 1757. Ashok V. Desai argued that, during the centuries of Mughal rule, Indian workers experienced greater purchasing power than once thought, greater indeed than they would under the British Raj.[75] Parsannan Parthasarathi has recently contended that, 'very far from the received wisdom of unmitigated oppression and poverty', Indian labourers were not that poor after all, and 'possessed several important advantages over their counterparts in Britain', among them the advantage of greater agricultural productivity, and consequently lower grain prices.[76]

This fact was acknowledged by Adam Smith as one of two contributing factors, along with costs of overland transport, undermining European manufacturing competitiveness. Smith repeated the English contention that Asian workers suffered from lower monetary wages but emphasized as well the consequences of lower nominal prices for staples. 'The real price of labour', he argued,

> the real quantity of the necessaries of life which is given to the labourer … is lower both in China and Indostan, the two great markets of India, than it is through the greater part of Europe. The wages of the labourer will there purchase a smaller quantity of food; and as the money price of food is much lower in India than in Europe, the money price of labour is there lower upon a double account; upon account of both the small quantity of food which it will purchase, and of the low price of that food.[77]

Chinese and Indian manufacturing benefited from the lower real and monetary prices of their costs of production, thereby explaining the continuing necessity for European traders to carry precious metals, and particularly silver, to India, to make up the difference.[78]

Recent Indian scholarship supports the same conclusion. Thus, as Parthasarathi makes clear, 'South Indian cloth was cheaper because money wages were lower, a product of lower grain prices.'[79] Lower grain prices resulted from the greater productivity of Indian agriculture and resulting higher yields. Indian farmers, like those in China and Japan, experienced grain yields which more than doubled the returns to eighteenth-century English farmers.

74 Ashok V. Desai, 'Population and living standards in Akbar's time', *Indian Economic and Social History Review*, 9, 1972, p. 45.

75 *Ibid.*, p. 45.

76 Parsannan Parthasarathi, 'Rethinking wages and competitiveness in the eighteenth century: Britain and south India', *Past & Present*, 158, 1998, pp. 102–3.

77 Adam Smith, *The wealth of nations*, ed. Edwin Cannan, New York: The Modern Library, 1937, p. 206.

78 *Ibid.*

79 Parthasarathi, 'Rethinking wages', pp. 101–2.

Robert Marks contends that Indian and East Asian yields reached twenty bushels for each planted while England at best experienced 8:1 yield ratios.[80] Though there are other factors, the degree to which Indians employed human waste as fertilizer must be given consideration when accounting for the productivity of Indian farms. Moreover – and this cannot be too strongly emphasized – within the social context of India, the 'commons' of human waste only became accessible as an agricultural resource through the labour of men and women who could as a consequence of their caste status make little claim to the productivity increases deriving from their labour. The eighteenth-century comparative advantage of South Asian textiles, which drove the English to industrial innovation, thus in part rested on the labours of the region's scavengers, nightsoil men, and urine jobbers.

Asian conservancy and Europe's turn to chemical fertilizers

Adoption of chemically synthesized fertilizers, the use of which freed European and North American farmers from the higher labour costs associated with collecting and amassing vegetable and animal manures, or in feeding growing livestock herds to supply fertilizer demands, is rightly listed among the critical technological developments of the Industrial Revolution. Joel Mokyr, for example, argues that 'the productivity gains in European agriculture are hard to imagine without the gradual switch from natural fertilizers, produced mostly in loco by farm animals, to commercially produced chemical fertilizers'.[81] Before the importation of guano and other mined fertilizers and the adoption of chemically synthesized fertilizers, Europe and North America suffered from a nitrate deficit by comparison with their Asian competitors. The development of chemical fertilizers should therefore be seen as one response to Asian conservancy regimes.

Indeed, nineteenth-century European travellers and agricultural specialists often remarked positively on the zeal with which Chinese and other Asian farmers husbanded human manure. George William Johnson, describing the diligence with which Chinese households collected kitchen wastes and nightsoil, noted, 'We quote these facts because they show a whole nation alive to the importance of preserving everything that aids in the production of food; and if they were not thus careful, the soil would not be enabled to yield sufficient for the nourishment of the people – for China is the most populous empire in the world.'[82] Johnson was echoed by Georges Auguste Morache, who wrote, 'The sole point of public sanitation, which is well enough observed, is the collection of faecal material; which we know that the Chinese have from time immemorial used for fertilizing the land, and thus nothing of this product, precious to cultivation, is lost.'[83]

80 Robert B. Marks, *The origins of the modern world: a global and ecological narrative from the fifteenth to the twenty-first century*, 2nd edition, Lanham, MD: Rowman & Littlefield Publishers, Inc., 2007, p. 97.

81 Pomeranz, *Great Divergence*, pp. 216, 224–7; see also Robert Brenner and Christopher Isett, 'England's divergence from China's Yangzi delta: property relations, microeconomics, and patterns of development', *Journal of Asian Studies*, 61, 2, May 2002, pp. 613–14; Joel Mokyr, *The lever of riches: technological creativity and economic progress*, New York: Oxford University Press, 1990, p. 138.

82 George William Johnson, *Cottage gardener and country gentleman's companion*, vol. 2, London: William S. Orr and Company, 1849, pp. 63–4.

83 Morache, *Pékin et ses habitants*, p. 31.

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Perhaps the clearest assertion of this view was expressed by Justus Liebig, the scientist most often credited with developing chemical fertilizers. 'China', Liebig began, 'is the birth-place of the experimental art; the incessant striving after experiments has conducted the Chinese a thousand years since to discoveries, which have been the envy and admiration of Europeans for centuries.' He noted, however, that simply following principles deduced from the study of chemistry had made it possible for Europeans to surpass the Chinese in these same processes during the previous half-century – except in the realm of agriculture. Here Europe continued to lag. 'How infinitely inferior is the agriculture of Europe to that of China!' he lamented.[84]

Liebig had no doubt that the difference remained European unwillingness to conserve nightsoil and other manures. To support this conclusion, in a note the English editor, Lyon Playfair, quoted liberally from John Francis Davis's description of how Chinese peasants carefully husbanded horns, hoofs, soot, ashes, barbers' shavings, hair, animal dung, nightsoil, urine, even the mud used to plaster chimneys, and applied it directly to their plants.[85] He then recalled the Harvard professor John Webster's critique of European wastefulness. Where residents of Chinese cities carefully guarded their urine and nightsoil, seeing to it that it was 'removed daily, with as much care as our farmers remove their honey from the hives',[86] Europeans were profligate in their disregard for this resource. Playfair also remarked:

> When we consider the immense value of night-soil as a manure, it is quite astounding that so little attention is paid to preserve it. The quantity is immense which is carried down by the drains in London to the River Thames, serving no other purpose than to pollute its waters. It has been shown, by a very simple calculation, that the value of the manure thus lost amounts annually to several *millions of pounds sterling*. A substance, which by its putrefaction generates miasmata, may, by artificial means, be rendered totally inoffensive, inodourous, and transportable, and yet prejudice prevents these means being resorted to.[87]

Liebig, of course, noted these Chinese agricultural advantages while arguing that the answer for European farmers merely involved careful application of the principles of chemistry, which would allow Europe to surpass China in this realm as well.

Liebig's study of various types of manure supported his conclusion that the failure to utilize human waste was a costly mistake. He noted, for example, the quantities of nitrogen contained in excrement: 100 parts of human urine equalled 1,300 parts of fresh horse dung and 600 parts of cow dung. Liebig stated:

> If we admit that the liquid and solid excrements of man amount on an average to 1½ lb. daily (5/4 lb. of urine and ¼ lb. faeces), and that both taken together contain

84 Justus Liebig, *Chemistry in its application to agriculture and physiology*, ed. and tr. Lyon Playfair, 2nd edition, London: Taylor & Walton, 1842, pp. 194–5.

85 *Ibid*. p. 194, n. by Playfair, citing John Francis Davis, *The Chinese: a general description of the empire of China and its inhabitants*, New York: Harper & Bros., 1836, p. 151.

86 Liebig, *Chemistry*, p. 194, n. by Playfair, citing a personal communication from John Webster.

87 *Ibid*., p. 194, n. by Playfair.

> 3 per cent. of nitrogen, then in one year they will amount to 547 lbs., which contain 16.41 lbs. of nitrogen, a quantity sufficient to yield the nitrogen of 800 lbs. of wheat, rye, oats, or of 900 lbs. of barley.[88]

Liebig was not alone in noting the favourable qualities of human waste as a fertilizer. In a study carried out in Dresden and Berlin, application of human waste to fields, which when un-manured yielded three bushels for each sown, was said to yield fourteen bushels. This compared favourably even to *poudrette* and guano.[89] A. W. Crews repeated these findings in 1880, noting that land sown with 'old herbage, putrid grass or leaves' will produce a five-fold yield, seven-fold if ploughed with cow dung, nine times the seed if manured with pigeon droppings, a ten-fold increase if cultivated with horse manure, and, finally, a twelve-fold yield if manured with sheep or goat dung. Fertilizing fields with human urine, however, resulted in yields of twelve times the seed, and human excrement produced a yield fourteen times the amount planted. Moreover, Crews contended that, given a higher-quality soil, human manure might even return 'nineteen and two-thirds the sown quantity'.[90] The primary advantage of animal manure, given the greater yields which apparently resulted from applications of human manure, remained simply the greater quantities produced by cattle and horses.[91] Thus, throughout the nineteenth century, agricultural experts both lamented the waste of human ordure and urine, and also listed the benefits that its use promised farmers.

Nineteenth-century reformers likewise emphasized the economic riches being squandered by European cities. As early as 1788 Restif de la Bretonne had maintained that 'The inhabitant of Paris, who has no idea how precious fertilizer is, seeks only to dispose of it.'[92] The nineteenth-century French socialist Pierre Leroux bewailed the ignorance of Londoners: 'What a stupid city! One only needs to see this swarm of poor people to understand what wealth [lies in] a city's manure.'[93] Victor Hugo complained that 'Paris throws twenty-five million francs a year into the water.'[94] Henry Mayhew acknowledged that 'the removal of the ordure of towns to the fields … concerns not only our health, but what is a far more important consideration with us, our breeches pockets'. Mayhew calculated that, with a return of £10 for each 100 tons of sewage, and with 40 million tons of sewage annually discharged into the Thames, Londoners were 'positively wasting £4,000,000 of money every year, or rather, it costs us that amount to poison the waters about us'. Calculating the value

88 Liebig, p. 195.

89 *Annals of horticulture and year book of information on practical gardening*, London: Charles Cox, 1848, pp. 493–4.

90 A. W. Crews, *Manures: their respective merits, from an economical point of view*, London: Horace Cox, 1880, p. 68.

91 John Buck, *Land utilization in China*, Nanking: University of Nanking, 1937, p. 258, cited in Dwight H. Perkins, *Agricultural development in China, 1368–196*, Chicago, IL: Aldine Publishing Co., 1969, p. 71.

92 Nicolas-Edmé Restif de la Bretonne, *Les nuits de Paris or the nocturnal spectator: a selection*, tr. Linda Asher and Ellen Fertig, New York: Random House, 1964, pp. 92–3.

93 Pierre Leroux, *La grève de Samarez*, vol. 1, Paris: Librairie de E. Dentu, 1863, pp. 308–9, cited in Dana Simmons, 'Waste not, want not: excrement and economy in nineteenth-century France', *Representations*, 96, 1, Autumn 2006, p. 73.

94 Victor Hugo, *Oeuvres complètes*, ed. Jean Massin, Paris: Club Français du Livre, 1969, p. 873, quoted in Reid, *Paris sewers*, p. 54.

of that sewage another way, as the new increase in wheat production gained from careful exploitation of the city's 40 million tons of ordure, Mayhew complained that 'we fling into the Thames no less than 246,000,000 pounds of bread every year'.[95] Nor did the gradual adoption of the water closet and more efficient sewage systems entirely diminish the sense that Europeans were still flushing away substantial earnings.[96]

While these reformers bemoaned the annual loss of human manure as a resource, farmers and municipal authorities were increasingly exploiting the substance. Guy Dejongh has argued that population growth in northern Flanders after 1750, for example, resulted from increased crop yields that were largely due to 'more intensive soil cultivation and improved methods of fertilization', in particular 'increasing uses of urban manure'.[97] Rising cereal prices and population growth after 1750, according to other agricultural historians, necessitated more labour-intensive methods, reduction of fallowed acreage, and the planting of nitrogen-rich legumes, potatoes, or sugar beet, but also increased application of fertilizers, including human waste.[98]

As a consequence, in European cities after 1750, efforts to conserve human waste and employ it for agricultural uses proliferated. Paris and Flanders provided models for both municipal conservation efforts and examples of the improved yields which might be acquired from nightsoil. As a result of Flemish farmers' long-standing use of human waste for agricultural use, perhaps as early as the late Middle Ages, urban manures were not infrequently described as Flemish manure.[99] Unlike the practice that developed in the Parisian hinterland, Flemish farmers applied liquefied urine and excrement directly to their fields. By contrast, in the latter decades of the eighteenth century, Parisian authorities and entrepreneurs developed both sludge farms and *poudrette* processing plants. In the latter case, nightsoil was dried in drying ovens and then sold in casks to farmers willing to pay for the substance.[100]

Parisian and Flemish farmers were not alone. According to Abbé François Rozier, in his multi-volume *Cours complet d'agriculture pratique*, first published in 1781, Lyonnais farmers employed tumbrils and donkeys to transport the city of Lyon's accumulation of street sweepings, nightsoil, and kitchen wastes to their farms. He also noted that the city of Geneva had found demand for nightsoil and other urban waste a lucrative source of income for the municipality.[101] Similarly, in both Edinburgh and Glasgow, reports in 1815 noted the

95 Henry Mayhew, *London labour and the London poor*, quoted in Johnson, *Ghost map*, p. 116.

96 Jamie Bendickson, *The culture of flushing: a social and legal history of sewage*, Vancouver: University of British Columbia Press, 2007, p. 120.

97 Guy Dejongh, 'New estimates of land productivity in Belgium, 1750–1850', *Agricultural History Review*, 47, 1, 1999, pp. 27–8. See also William H. Rham, *The outlines of Flemish husbandry*, London: Baldwin and Cradock, 1840, pp. 20–4.

98 J. L. van Zanden, 'The first green revolution: the growth of production and productivity in European agriculture, 1870–1914', *Economic History Review*, 44, 2, 1991, pp. 215–39.

99 Edwin Chadwick, *Sewer manure: statement of the course of investigation and results of experiments as to the means of removing the refuse of towns in water, and applying it as manure*, London: Reynell & Weight, 1849, p. 44. Chadwick reproduces Jean-Baptiste Boussingault, *Économie rurale considérée dans ses rapports avec la chimie, la physique, et la météorologie*, Paris: Bechet Jeune, 1843–44.

100 See Reid, *Paris sewers*, pp. 53–70; Simmons, 'Waste not, want not', pp. 73–98.

101 François Rozier, *Cours complet d'agriculture pratique, d'économie rurale et domestique, et de médecine vétérinaire*, vol. 1, Paris: F. Buisson, 1809, pp. 545–7.

ready availability to farmers of great quantities of 'nightsoil or street-dung' kept in ash pits maintained in the two Scottish cities.[102]

Across the Atlantic, American agricultural experts followed suit in recommending use of nightsoil. Willis Gaylord, in a manual written for the New York State Agricultural Society, opened his discussion by recognizing the Chinese as long celebrated for extensive use of nightsoil, and pointed out more recent European examples, before describing for American farmers how best to use human wastes as fertilizers.[103] Commercially orientated farmers took the advice to heart: market gardeners outside Baltimore and Boston eagerly sought sources of nightsoil, either arranging to collect it themselves or buying it from scavengers.[104]

In Europe and North America, however, this intensification of labour inputs and increased utilization of nightsoils only continued until the 1870s. J. L. van Zanden argues that, during that decade, agriculturalists across Europe and North America faced the dual challenge of falling grain prices coupled with rising real wages. As a result, commercially orientated farmers increasingly shifted to chemical fertilizers to improve yields.[105] So, while European cities did initiate efforts to conserve nightsoil and market it to area farmers, after 1870 these efforts were superseded by the growing use of chemical fertilizers. The turn to chemical fertilizers, coupled with municipal investment in the interlocking systems of metered public water provision and urban sewage, represented a significant departure from the labour-intensive but effective and equally interlinked regimes of organic fertilizer and nightsoil conservancy, which had contributed so importantly to Asian agricultural practices in the early modern period.

Conclusion

R. Bin Wong has argued that 'one way to move beyond the great social theorists of the nineteenth and early twentieth centuries' is through the use of fresh perspectives deriving from both European and Chinese, or more broadly Asian, history. According to him, such a project necessitates the deployment of reciprocal comparisons which do not privilege processes, institutions, or explanatory categories that featured in the development of western Europe.[106] The history of nightsoil men and women, and the differential uses of human excrement and urine, provides one field of study with which to engage in such reciprocal comparisons.

Comparisons of urban waste-removal efforts during the early modern period suggest a number of features common to this labour in both Asian and European cities. One commonality

102 'Of land occupied by farmers in Scotland, from the General Report, recently published by the Board of Agriculture', in *The farmer's magazine: a periodical work exclusively devoted to agriculture and rural affairs*, 16, Edinburgh, London: Archibald Constable & Co.; Longman, Hurst, Rees, Orme, & Browne, 1815, p. 193.

103 Willis Gaylord, 'Essay on the preparation and use of manures', in *Transactions of the New York State Agricultural Society together with an Abstract of the Proceedings of the County Agricultural Societies for the Year 1842*, vol. 2, Albany, NY: E. Mack, Printer for the Senate, 1843, pp. 78–80.

104 Karen Stupski, 'Waste, wealth and public health: recycling human excrement in the New England and mid-Atlantic states, 1820–1900', PhD thesis, Johns Hopkins University, 2001, pp. 71–9.

105 Van Zanden, 'First green revolution', p. 216.

106 R. Bin Wong, *China transformed: historical change and the limits of European experience*, Ithaca, NY: Cornell University Press, 1997, pp. 1–8.

across the early modern urban landscape was the degree to which casual labourers, recent immigrants, or outcasts frequently provided the labour force for much of the dirty work associated with waste removal, though sanctioned guilds or organized entrepreneurs sought and acquired legal rights to participate in the trade, or gained monopolies over the raw materials collected by this workforce. Despite these common features, a significant difference was that in Asian cities, as in Mesoamerica, much of the human ordure was transformed into an important agricultural resource, while in European cities this was more rarely the case before the late eighteenth century.

That European cities, with few exceptions, only belatedly began to encourage the conservation of human waste had implications not only for urban sanitation and agricultural productivity, but also in the reported wage differentials faced by Asian and European manufacturers. Moreover, the advantages accruing to Chinese, Japanese, and Indian cities as a result of Asian models of conservancy calls into question the significance of the heralded 'sanitation revolution' which took place in the mid nineteenth century.[107] The heroes of this narrative remain reformers such as Sir Edwin Chadwick, the inventors and entrepreneurs who developed and marketed the flush toilet, or the epidemiologists who discovered the linkages between waterborne diseases and unsanitary water supplies. Similarly noted in this narrative are the sewers constructed during the nineteenth century to transport urban waste, first to rivers and then to sewage farms and waste-water treatment centres.

This important history, however, disregards the equally effective approach of Asian cities, which derived from an ethos of conservation and a long-established attention to hygiene, considerations that hardly troubled Europeans before the nineteenth century. In addition, comparisons of the agricultural contributions of European waste-removal systems and Asian methods of conservancy, as mid nineteenth-century European agricultural experts and reformers were painfully aware, favoured Asian methods, which Europeans at first endeavoured to replicate. Indeed, these disadvantages were only overcome with the development of chemically synthesized fertilizers, which, coupled with other capital-intensive farming methods, provided European and North American farmers with the means to surpass their Asian counterparts.

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107 J. R. McNeill and William H. McNeill, *The human web: a bird's-eye view of world history*, New York: W. W. Norton, 2003, p. 266.