Water, sanitation and hygiene (WASH) the evolution of a global health and development sector

Wit, S. de; Luseka, E.; Bradley, D.; Brown, J.; Bhagwan, J.; Evans, B.; ... ; Chandler, C.I.R.

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Sara de Wit, Euphresia Luseka, David Bradley, Joe Brown, Jayant Bhagwan, Barbara Evans, Matthew C Freeman, Guy Howard, Isha Ray, Ian Ross, Sheillah Simiyu, Oliver Cumming, and Clare I R Chandler

Author details

Sara de Wit
Institute for Science, Innovation and Society (InSIS),
University of Oxford
64 Banbury Road, OX2 6PN, Oxford, United Kingdom
+44(0)1865278818
sara.dewit@insis.ox.ac.uk

Euphresia Luseka
Water Governance Expert
N/A
Nairobi, kenya
+254735593908
luseka@gmail.com

David J Bradley
Department of Zoology, University of Oxford
London School of Hygiene & Tropical Medicine
Zoology Research and Administration Building, 11a Mansfield Rd, Oxford OX1 3SZ
+447796694488
david.bradley@lshtm.ac.uk

Brown, Joe
Department of Environmental Sciences and Engineering, Gillings School of Global Public Health,
University of North Carolina at Chapel Hill
Rosenau Hall, Chapel Hill, NC 27599-7431, United States
+1 919 360 8752
joebrown@unc.edu

Jayant Bhagwan
Executive Manager : WaterUse, Wastewater Resources and Sanitation Futures
Water Research Commission
4 Daventry Place, Lynwood Manor, Pretoria 0081, South Africa
+27 12 761 9300
jayb@wrc.org.za

Barbara Evans
University of Leeds and Water@Leeds
Woodhouse Lane, Leeds, LS2 9JT
+44 113 243 1751
b.e.evans@leeds.ac.uk

Matthew C. Freeman
Emory University
1518 Clifton Rd. NE, Atlanta, Georgia 30322
+14047128767
matthew.freeman@emory.edu

Guy Howard

University of Bristol
Queens Building, University Walk, Bristol BS8 1TR
+447773816429
guy.howard@bristol.ac.uk

Isha Ray
Energy & Resources Group, UC Berkeley
338 Giannini Hall, Berkeley, CA 94720
5106421640
isharay@berkeley.edu

Ian Ross
London School of Hygiene & Tropical Medicine
Keppel St, London, WC1E 7HT, UK
+447766100561
ian.ross@lshtm.ac.uk

Sheillah Simiyu
African Population and Health Research Center,
Manga Close, off Kirawa Road
Box 10787-00100,
Nairobi, Kenya
ssimiyu@aphrc.org

Oliver Cumming
London School of Hygiene & Tropical Medicine
Keppel St, London, WC1E 7HT, UK
+442079272617
oliver.cumming@lshtm.ac.uk

Clare Chandler
London School of Hygiene & Tropical Medicine
15-17 Tavistock Place
London WC1H 9SH
+442072994709
Clare.Chandler@lshtm.ac.uk

Abstract

Background. Universal access to safe water, sanitation and hygiene (WASH) by 2030 – a remit of SDG6 – remains a distant prospect in the majority of countries. Policy-makers and implementers of the WASH sector are being challenged to track a new path. An analysis of core orienting themes of the sector, as legacies of past processes, can provide insights for its future.

Methods. We analysed documentary materials and 19 expert interviews to seek out the driving principles, imperatives and arguments made in the evolution of the WASH sector. We situated this evolution in relation to wider trends in global health and development over the same time period.

Findings. Four overlapping themes emerged that characterised the evolution of the WASH sector over the past 60 years of increasing globalisation: (1) a narrow focus on technologies (technicalisation), (2) the search for generalised solutions (universalisation), (3) attempts to make beneficiaries responsible for environmental health (responsibilisation) and (4) the shaping of programmes around quantifiable outcomes (metricisation).

Interpretation. The emergent commitment of the WASH sector to these core themes reflects a pragmatic response in health and development overall to depoliticize poverty and social inequalities in order to enable “action”. Recognizing these commitments leads to questions about what potential

solutions have been obscured, which might be understood as 'uncomfortable knowledge' – the knowns that have had to be unknown – encountered in the sector as concerns about deep inequalities, shrinking budgets and heightened awareness of the importance of WASH come to the fore.

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Introduction

With less than a decade of the Sustainable Development Goals (SDGs) remaining, the world is not on-track to meet SDG 6, and universal access to safe water, sanitation and hygiene (WASH) by 2030 remains a distant prospect in the majority of countries.[1] Recent evidence from large randomised controlled trials has called into question the public health benefits of some low-cost WASH interventions deployed today.[2-6] Disillusionment with the impact, sustainability and equity of investments in WASH – together with interrelated challenges grouped under the planetary health framework, such as climate change, urbanisation, and concerns over power dynamics written-into global health[7] – has put pressure on those working in the sector to revisit its direction. Calls have arisen for WASH to transform[8,9]; to move away from technical-focused approaches and bring people and politics to the heart of climate-resilient water and sanitation for all;[10] to incorporate intersectional and gendered approaches to vulnerability into research and practice;[11-13] and to decolonise the sector.[14,15] Understanding the factors that have shaped the sector and its priorities, principles, technologies, and practices to date can guide the sector towards the desired 'transformation'.

Much can already be learned from scholarship on the history of WASH efforts in different settings around the world,[16] with a focus on, for example: urban sanitation planning;[17] international water politics and development discourses; [18-20] how thinking around water evolved between 1978 and 1998;[21] 'The Water Decade';[22] lending in the rural water sector;[23] hygiene and sanitation software;[24] monitoring & evaluation;[25-27] cost-effectiveness and quantification at the World Bank;[28] the role of the Joint Monitoring Programme (JMP) for Drinking Water, Sanitation and Hygiene;[29] and gendered water access, health and participation.[11,13] Extending beyond these analyses to link the evolution of WASH as a sector to wider trends, forces, and imperatives in global health and development is critical for understanding not just the chronology of events but to render visible the scaffolding upon which priorities, programmes and practices have been built.

Historical, philosophical and anthropological studies have fruitfully examined the emergence of particular modes of thinking and doing in health[30],[31] as well as water.[32] Analysis of discourses, including Foucault's approach to charting genealogies of particular terms as dominant discursive objects, is one route to this. Here, discourses do not merely represent and designate things; they are practices that emerge from specific historical conditions. They both name, and systematically form, the objects of which they speak. Such objects – in our case the 'WASH sector' – emerge in relation to 'institutions, economic and social processes, behavioural patterns, systems of norms, techniques, types of classification, modes of characterisation'[33 (p. 45)]. Thus, a genealogical approach here traces the ways in which the WASH sector has been brought into being through these relations that will have privileged certain ways of knowing and practicing over others. In this paper, we look back upon more than six decades of pragmatic, academic and policy activity on WASH to describe how the sector evolved. We retrieve key ideas and ideologies that shaped this evolution. We identify four themes that have – often implicitly – come to define the parameters and operation of the WASH sector. Each theme reflects broader trends in global health and development. We argue that these have served to parse the 'uncomfortable knowledge' (the unknown knowns)[34] that those working in this field sit with, compelled to achieve progress through depoliticised "solutions". By revisiting the WASH sector through its evolution, this paper hopes to contribute to the reorientation of the sector's future.

Methods

We describe how the WASH sector has been shaped over the past 60 years by both internal changes in the sector and the external forces of the global political economy and development apparatus, and how in turn this has impacted on national agendas.

We searched for material documenting the development and evolution of the WASH sector including academic literature, policy documents, conference proceedings, and a range of other media in the public domain using online searches and snowballing methods from existing citation lists and expert recommendations. With written informed consent, we carried out 19 semi-structured expert interviews (see Appendix 1 for semi-structured interview guide) to elicit oral histories and gain insight into the perspectives of individuals who have been within or adjacent to the sector from a variety of roles, expertise and regions. We consulted documents written in English and WASH experts who spoke English. Ethical approval was granted by the London School of Hygiene & Tropical Medicine observational committee (reference: 22968).

Analysis was iterative. We assembled relevant documents in a shareable timeline online (in Padlet), which respondents and the co-author group could review and add to. Analysis of these documents – which grew to over 50 – aimed to identify the driving principles, imperatives and arguments made over the last six decades as the WASH sector has emerged as an entity. For example, we sought out statements that made the case for particular responses and traced how these evolved over time. We situated this WASH-specific documentary analysis in relation to wider trends in global health and development over the same time period, to provide context to the themes that appeared to be driving the sector. We drew on the expert interviews to direct our attention to junctures, achievements, disagreements and challenges over time from the perspectives of those with a passion to improve water, sanitation and hygiene from a range of positions. As we worked through the interview and documentary materials to identify core tenets of the sector, and tested our interim interpretations with our respondents and wider collaborator groups, the themes that could capture the diversity of strands of thinking became higher-order. We arrived at four overarching themes: technicalisation, universalisation, responsibilisation and metricisation.

[Box 1 here]

Our genealogy treats WASH as a global object – a 'sector' – that is not fixed, but is being continually re-made through global practices and imperatives. It traces the emergence and evolution of WASH primarily within a public health and development sphere where it was activated by linking water, sanitation and hygiene (formerly 'health') up to the advent of SDG 6 and the present day (SDG 6, see Box 1). The fusion of water, sanitation and hygiene as WASH may appear inevitable, yet a historical excavation reveals contingent forces that have influenced the assembling and stabilising of these relationships.

Findings

Constituted by a variety of different stakeholders, including national and international non-governmental organisations (I)(NGOs), multilateral (aid) organisations, private enterprises and governments, the WASH sector has a coherent presence on the global health and development stage. This analysis focuses on the health-specific assemblage of WASH. A recent global assessment reports that 94% of countries have national policies for drinking water and sanitation, and 79% have policies

for hygiene; yet a large majority of countries lack the human resources needed to implement national WASH plans.[35] WASH sector constituents share an overall goal to increase access to safe water and sanitation, and thereby reduce the burden of disease from exposure to microbial and chemical contaminants in water sources or transmission routes (such as hands and food). Their efforts have focused on technological, infrastructural and behavioural solutions that deliver measurable impacts on public health, notably in high-burden settings among children under five and other susceptible populations.

Mirroring other global health and development sectors, WASH has experienced tensions within its priorities over time, such as: a narrow focus on technology or technological systems versus a more inclusive approach (beginning with the International Water Decade and epitomised by The New Delhi Statement "some for all rather than all for some"); the balance between infrastructure versus behaviour; the roles of government versus market/community; demand-based approaches versus utility/ service delivery; subsidy versus zero-subsidy approaches (as propagated by the community-led total sanitation (CLTS) movement); and direct service delivery versus investing in government programs or capacity support. Unpacking these tensions and tracing convergences through our interviews and the wider literature on WASH, and seeing successive periods of health-and-development practice as discursive regimes, we identified several themes that mirrored wider ideological orientations and appear to have shaped the development of WASH as a field of expertise and practice. We have grouped these as four overlapping themes (Box 2, Figure 1): technicalisation, universalisation, responsibilisation and metricisation.

[Box 2 and Figure 1 here]

The commitments characterised in the four themes emerged in succession but have continued to co-exist, albeit with (dis)continuities, as illustrated in Figure 2. We observed the emergence of a shared understanding of WASH as a human development and disease control issue to be solved through science, technologies and cost-benefit justification. As WASH evolved within the shifting landscape of international development paradigms and ideas of global health (depicted in the upper part of Figure 2), with disease prioritisation changing over time,[36] we observed the importance of scientific and technological developments – comprising expertise, practices, systems, devices and materials – as well as the rise of behavioural and social marketing approaches, as dominant models of national policy, technical assistance and aid.[37] Underlying these themes, a need to depoliticise is evident – by which we mean the conceptual and practical cementing of WASH as separable from local and transnational politics and other power relations. Thus, each theme describes a vehicle for pragmatic attention and action within given parameters. Below, the themes are drawn out in broad chronology whilst recognising connections and continuities.

[Figure 2 here]

Technicalisation: creating the need for WASH through technical disease control

The origin stories of the global WASH sector may be traced back to the mid-19th century European ideas about disease control and water. Hungarian physician Ignaz Semmelweis was a pioneer of hand washing, having mandated in 1847 the practice of washing hands with chlorinated lime to reduce infections in the maternity clinic where he worked.[38] During the 1848 and 1854 cholera outbreaks in London, physician John Snow demonstrated that the source of exposure was the water supply, which

challenged the prevailing miasma theory of disease transmission. This event largely influenced the belief that water quality was the most important aspect in controlling specific disease outbreaks.[39]

Early work in the field of environmental engineering focused almost exclusively on water supply for municipalities, which led to a greater focus on ensuring the quality of this water rather than quantity, a problem in rural and later rapidly urbanising areas. Although attention to diverse geography and to other modes of relating water to disease transmission, as exemplified in the significant 1970s study "Drawers of Water" by White and colleagues[40] and related research,[41-43] the notion that "clean water" is an important precondition for diarrhoeal disease control persists among many engineers today (respondent #9).[44,45] Scientific findings on disease transmission, vectors, microorganisms and pathogens paved the way for a paradigm on water, sanitation and health ("H" initially stood for Health).[23]

One of the first comprehensive studies of water, human health and excreta disposal in a rural context relevant to tropical climates was a WHO monograph by public health engineers Wagner & Lanoix in 1958.[46] The authors perceived 'proper excreta disposal' to be 'among the most pressing public health issues'[(p. 9)]; a finding that has been endorsed by public health studies until today.[24,47] The problem of faecal oral transmission was described in their F-diagram (see Figure 2) and has influenced how environmental and sanitary engineering solutions are imagined, and is still taught at global health institutions as a 'total system', sometimes adapted with additional elements such as animal faeces.[48] The technical objective of WASH as a health project, as the F-diagram shows, is to break the transmission routes by which diarrhoeagenic pathogens pass from infected individuals to new hosts.[46]

[Figure 3 F diagram]

Drawers of Water informed how water and sanitation were conceived and delivered. The classification of water-related disease by transmission route, rather than on the taxonomic or clinical characteristics of the pathogens as was common in preceding medical texts [(for example,49)], framed water and sanitation in a new way. The book also highlighted the importance for health outcomes of increasing the quantity of, and access to, water, beyond a focus on microbiological quality.[40,50-54] The framings here enabled solution-oriented engineers to tailor their interventions to maximise health benefits.[55] The insight that some faecal-oral diseases are "water-washed" (which refers to transmission by *lack* of water for appropriate washing) rather than water-borne, and have multiple transmission routes, paved the way for an interest in the study of hygiene behaviour.[47,56]

Technical approaches to disease control may involve a narrow focus on a technological object, like a hand pump or pit latrine. They can also include practices that Foucault described as technologies of power and of the self, that shape and constrain how individuals conduct themselves in society and with respect to their own bodies and thoughts.[57(p17-18)] These include ways of doing, classifying and policing that become common-sensical within a particular paradigm. Ultimately, the assemblage that was to emerge as WASH was laying its roots in an awareness that (1) hygienic management and disposal of human waste was crucial to control associated infectious diseases and that (2) developing countries were plagued with endemic diarrhoea occurrence, high levels of faecal contamination in water, the 'unsanitary habits' of local populations, and a lack of resources for public health. These concepts incentivised health planners and economists to explore the roles of water supply and sanitation as a means to control diarrhoeal disease;[45,58] these principles continue to shape the field today even if the disease picture has changed, for example in the burden of diarrhoea.[59]

The framing of WASH challenges in technical terms became not only a 'self-evident' solution to a problem but also a depoliticizing device that reposed political questions – related to power dimensions, poverty and deeply unequal control over resources and rights – as amenable to technical

interventions.[60] An example is the widespread political support that was eventually galvanised for Oral Rehydration Techniques (ORT) by the 1980s under the auspices of a 'magic bullet', after initial challenges by the medical profession. Although designed to manage acute diarrhoea, ORT became embraced by bilateral agencies as a solution to diarrhoea and dehydration in general in the developing world. Thus, in providing a remedy for diseases caused by unsafe water and sanitation conditions, ORT allowed public attention to be deflected from the political and economic causes of these conditions.[61-63] This practice of "rendering technical" is not unique to WASH but has been characteristic of the wider field of development cooperation and the post-war period in public health until today.[31,63] Rendering technical is never neutral as it "both limits and shapes what improvement becomes"[64(p7-8)]. It has a long history of association with modernity's narrative of progress. Such technicalisation can have the, perhaps inadvertent, result of obscuring the social and political structures that underlie poverty and inequality, and that have been produced historically within and across nations.[10]

Universalisation: infrastructures based on Western blueprints

A precondition for the wide circulation of scientific ideas and technologies to the "Third World" was the success and institutionalisation of international health as a field.[31] The post-World War II period in a broken Europe keen to reconstruct, including through transferable technology, fostered ideas of progress on sanitary transformation and municipal services – water, sanitation, improved housing, waste management, drainage – which all became part of the founding cornerstones of public health in the World Health Organization (WHO). The establishment of the WHO in 1948 was linked to a development ideology in which health efforts were entangled with political influence in "underdeveloped" countries, including former colonies, and related to larger Cold War struggles.[31] In view of the postcolonial mission to eradicate poverty, Bretton Woods Institutions emerged, and the World Bank in particular envisaged the universal transfer of the models of municipal engineering that were designed in Europe and the U.S. to Africa and South Asia.[65] In parallel, Soviet expansion after the Cold War involved the training-up by the USSR of Africans from recently independent countries in a range of medical and technical capabilities, including engineering for infrastructural development.[66]

The origins of WASH as a funded global sector was thus rooted in a universalised orientation, driven in part by the desire to alleviate poverty and by the Great Powers (re)building their spheres of influence. By the 1970s, public management by the state, large-scale infrastructure development and supply-orientation dominated water policy internationally.[19 (p137)] Influential actors like the World Bank focused on funding large urban, top-down, wastewater treatment and piped water supplies[23 (p42)]. Environmental engineering education flourished in the 1970s and 80s in Europe and the U.S. and focused to a great extent on the challenges and solutions applicable in Western societies, a curriculum that was also followed in the South, benefitting both engineering firms and WASH consultants.[55] The attraction of such capital investment was not met with support for operation and maintenance, which fell to local communities (respondent #12). It was not until the 1980s that a growing body of scientific studies began to acknowledge that challenges in developing countries were often of a different nature than the promoted technologies were designed for.[41] This period saw increased efforts to standardize and improve hand pump for community management.[23]

Through the 1970s, the limitations of development models reliant on the transfer of technologies and resources to the developing world, which had little impact on poverty eradication, became increasingly apparent. In water and sanitation it was clear that low-income groups were often excluded from standard service delivery because piped water and sewerage systems – the standard Western model – was mainly extended to urban elites and was beyond the reach of peri-urban and rural communities.[21,65] Self-reliance and community participation emerged as alternative models and

ideas for redress were discussed during the manifold international conferences that further solidified the sector.[21(p6)] The publication of Limits to Growth in 1972[67] heralded the environmental consciousness of a looming water crisis and the need for more efficient local uses of water. The emphasis on the local also contributed to a shift towards community-level engagement, which became a stepping stone towards what was eventually called demand-based management.[19 (p138)]

The global coordination of water, sanitation and hygiene became centralised through UN agencies. International NGOs also emerged at this time, with perhaps the largest iNGO focused exclusively on WASH, WaterAid, created by a grant from the UK water industry with a mandate to expand access to safe drinking water globally. The Water Decade (IDWSSD, see below) of the 1980s was later followed by the Water for Life decade from 2005-2015 along with the Millennium Development Goals from 2000 to 2015, and subsequently the SDGs from 2015-2030. From the early 1990s, the World Bank, the United Nations Development Program (UNDP) and UNICEF – together with some research and development banks with large investment profiles – emerged as key players in the delivery of water .[28 (p18)] while the WHO maintained a key normative role throughout this period. Since the 1977 Mar del Plata UN Water conference, the idea of water as a human right gained traction, with a UN General Assembly Resolution in 2010 recognising the universal right to water and sanitation.

Whilst blueprints for universal physical infrastructure lost dominance over the decades, the WASH sector, especially in urban contexts, nonetheless evolved with standardised models of development that did little to challenge unequal relations between a Western 'core' and developing country 'periphery.'[68] This involved mobilising guidelines, toolkits and monitoring apparatus – increasingly adaptable with the rise of community participation. The ties to these discourses and intentions meant that WASH became naturalised as a developing countries issue; water quality research and regulations continued in high-income countries but remained largely separate from the global WASH agenda.

Responsibilisation: privatisation, community participation & behaviour change

The Water Decade: towards "Water and Sanitation for All" by 1990

The Mar del Plata Declaration in 1977 adopted the UN International Drinking Water Supply and Sanitation Decade (IDWSSD 1981—1990) with the ambitious goal to achieve "water and sanitation for all by 1990."[69] The Decade's focus on health, alongside water as a scarce environmental resource, affected technology choice.[22 (p1934)] It was acknowledged that to increase coverage, lower levels of service were necessary in the majority world, and that too narrow a focus on technology would not solve the world's sanitation problems.[70 (p224)]. While the goal of universal access was unattainable by most (low-income) countries, it arguably lent political weight and funding to international assistance, which was now open to the view that radically different, low-cost technologies could be needed.[21(p6)] Schumacher had already coined the "Small-is-Beautiful" idea that "intermediate" or "appropriate technologies" needed to be much more sensitive to local contexts than the earlier capital-intensive technologies.[71,a] Emerging alongside the Primary Health Care movement, the Decade's solution was to shift the focus from the existing supply-driven orientation and questions around 'hardware' to demand-driven approaches and issues around 'software', including health education, the question of motivating people, and training and organising to install and maintain facilities.[39 (p2)]

A major challenge for reform efforts in the sector has been how to finance the creation and maintenance of infrastructure. Here we outline the three key elements that reflect the gradual shift

[a] At the Mar del Plata Conference, Schumacher originally proposed the phrase "appropriate *use of* technologies", which was subsequently erased from the Declaration to his great dismay (respondent #4).

towards demand-led management, holding citizens and communities responsible for WASH services, and reducing the influence of cash-strapped states: privatisation, community participation and behaviour change approaches.

Privatisation

Despite the Water Decade's ambitious goals, investment in the sector under structural adjustment programmes actually decreased.[28] Water-sector reforms gained pace in low-income countries during the Thatcher-Reagan era.[72] The Washington Consensus (1989) and Structural Adjustment Programmes (SAPs) imposed on low-income countries made aid conditional upon, inter alia, private sector involvement, the reduction of state expenses and subsidies, the deregulation of markets and securing private property rights.[73] The Dublin Conference (1992) was a milestone for the privatisation of the sector when the economic value of water was recognised (Dublin Principle 4[74]). Economists observed that poor people are in fact willing to pay for water, leading to higher user fees and a move towards privatisation.[75] We distinguish here between two forms of privatisation: 1) the transfer of services from public to private control, including hybrid engagements; and 2) the rise of private entities and their repositioning as legitimate development and public health actors post-2000 (e.g. soap producing multinationals, see section on behaviour change). Increased Private Sector Participation was seen as an important element in achieving public health benefits.[76,77] In the wake of the slow state-led expansion of WASH services, it was argued that the market could deliver greater efficiency in management of water resources; and that water user involvement would automatically result in improved efficiency and equity (a shift from being 'beneficiaries' to 'customers'). This was seen as a way to bear the costs of infrastructure and services, accelerated the move towards participatory approaches especially in rural areas (notably targeting women), and promoted demand-based management overall.[19,78]

Although it was recognised that *some* costs may need to be passed to consumers, for running and repairs, private sector participation often led to rising prices.[79] These were challenged for example through the argument for the *right to water*, highlighted in the Cochabamba Water Wars of 1999-2000, when violence erupted in the face of rising water prices following privatisation of Bolivian water services as part of an agreement with the World Bank.[80] In 2003, The Camdessus Report supported the diversification of funding sources including aid, loans, markets and tariffs, to overcome the global deficits in water provision.[81] However, the large investments expected to flow from the private sector never materialised [44,82] and neither did the promises of privatisation.[77,83] In sub-Saharan Africa, the impact of privatisation has been most acutely felt by the poorest for whom access to water and sanitation has remained low or worsened.[84]

Participation's populist guise: the move towards responsibilisation

The Decade's most radical shift called for a new approach to water sector development away from governments towards community participation, management and financing.[74,85] In part the shift reflected disillusionment with state-led water sytems that had failed to reach large numbers of the rural poor, and had done little to increase for the rural poor. This move was a challenge for politicians in low-resource settings for whom water had been an important patronage tool, and where structures were not in place at the grassroots level for supporting such goals, making genuine hand-over of ownership to local communities challenging. Moreover, many communities had difficulty identifying their needs because they were not in a position to formulate the problem, and thus "were left with the ominous task of becoming masters and guardians of their universe."[22 (p1932)] The idea of community participation can be traced back to left-wing roots that popularised the idea of 'empowerment' in the 1970s, and was also aligned with the Primary Health Care movement during the 80s and 90s. Increasingly, however, the participation movement became underpinned by a neoliberal political ideology, becoming more an instrument to achieve local contributions to service-delivery costs than a tool of community autonomy.[19 (p180)] Thus the move to signal demand and target investments to

communities with the greatest need[86] subtly shifted towards 'individualisation' and 'responsibilisation' of local communities, explicitly diminishing the role of the state in service provision. Instead of institutionalizing actual political participation and including the grassroots in decision-making, participation was often cited as a guise for the large-scale removal of state-control and state regulation, and for the introduction of market mechanisms supplanting public sector responsibility.[23,87,88]

The shifting responsibility towards community under the "participatory" agenda is closely related to the gender and WASH agenda, which, since The Dublin Principles (principle 3, UN 1992), encouraged women to become active participants in water management. Community responsibility often devolved to women's groups and mothers' groups who carried out the (usually unpaid) work of mobilizing resources, maintaining water systems, and ensuring consistent safe water practices. This trend received some pushback from feminist scholarship about the essentialising effects of such discourses that, instead of liberating women and giving them more control and autonomy, placed ever-greater burdens on their workload.[13,89,90] Moreover, low-cost technologies and the commodification of water indirectly benefitted from the unpaid and undervalued labour of women, who could be further marginalised if they did not control the household budget (ibid) through gendered patterns of care and domesticity.[91]

Hygiene and behaviour change

Another manifestation of responsibilisation occurred in the early 1990s, when epidemiological approaches began to inform the study of human "hygiene behaviour", including household water treatment,[92] as a factor to overcome WASH-related disease transmission. Premised on the idea that governments cannot give access to safe supply of drinking water in the short to medium term, the social marketing of hygiene unfolded as a motivation to poor people in low-income countries to change their sanitation behaviour. Large scale hygiene programmes were initiated to encourage alignment with epidemiological findings (e.g. wash hands with soap and safely dispose of stool). The notion that improved health required behaviour change solidified, with efforts channeled into measuring the influence of behaviour change on health (respondent #9). [93,94,47,95] The domination of diarrhoeal metrics as primary goals of WASH obscured smaller-scale narratives of the value of hygiene for dignity or development in general, which were to become more of a focus in later efforts to incorporate menstruation management into sanitation and hygiene frameworks.[96]

In the late 1990s, consumer studies highlighted the complexity of hygiene behaviour and concluded that 'simply' teaching people about health was not going to alter behaviour. Instead, it was argued that positive images and population-scale marketing that motivated consumer behaviour (through emotional drivers) were needed.[97] These studies saw an expanded role for the soap industry, when public private partnerships (PPPs) emerged to become involved in marketing and communication to promote handwashing and sell soap. As the market for soap products displayed stagnant growth in developed economies, multinationals saw new opportunities in developing countries to 'cater for the needs of the poor.'[98(p9)] The rise of private entities combined with the call for social marketing approaches, repositioned multinationals as key actors in promoting health. This trend further rendered individual households – notably mothers – responsible for the health of the family.[99]

The focus on hygiene promotion, while recognising that access to clean water and sanitation alone will not bring health, at times appeared to overlook the socio-economic and environmental condition of the recipients upon which the practice of 'hygiene' is dependent, as "ill-health is created and sustained within a complex ecology of rural and urban poverty." [22(p1935 citing 77)] Most of what we have come to think of as WASH is highly water intense, while in environments of low water access, 'proper' hygiene behaviour is very difficult to sustain (respondent #6). Behaviour change approaches emerged as a low-cost solution to the failures of technological interventions and gaps in infrastructure.

Centralised water treatment systems were too expensive and benefits would accrue only in the long-term, hence quick-fix solutions were proposed and sought in participation and health education, in behaviour change approaches and in household water treatment that was enthusiastically promoted from the 2000s (respondent #5). This move towards the responsibilisation of the poor is part of a larger trend in the sector that has been driven by the implicit assumption that the burden of making WASH successful can be carried by user communities, despite many critiques that the poor and marginalised are least able to bear this burden.[20,22] While the behaviour change paradigm in WASH – in which technologies of shaming and blaming ("triggering") of the poor are often promoted – has been critiqued within the sector,[100-102] it continues to underpin many current interventions. Scholars focusing on a range of other public health fields have identified the impact of shame-inducing techniques that are intended to elicit particular healthy behaviours though they also (re)produce stigma, causing further damage to groups that are already socially vulnerable.[103] The construction of such narratives that morally disqualify marginalised communities[104] for 'improper hygiene behaviour', are essentially story technologies invested with (social) scientific legitimacy[105,106] that result in practical responsibilisation of the poor and perpetuate historically produced power relations.[7]

Metricisation: Measuring and evaluating for accelerated development & 'evidence-based international health programming' – MDGs and SDGs

Knowing the reach and impact of WASH efforts, and quantifying the benefits of water and sanitation has always been difficult.[28] Since before the Water Decade, concern was growing – particularly at the World Bank – to demonstrate the cost-effectiveness of water and sanitation investments,[107] and among scientists that these programmes could be more effective if better evaluated.[108] These concerns were sharpened by the reduction of state support for WASH and precipitated a focus on metrics – technologies of measurement – to concentrate efforts in WASH and other health and development fields, both in policy arenas and amongst scientists.

Metrics of WASH policy

The history of global targets and monitoring organised around water and health dates back to 1959,[109] not long after the establishment of the WHO. Since then, targets, indicators and definitions have shifted in relation to measurement of 'access' to 'safe' water and 'adequate' sanitation.[25,27,35,110,111] The radical shift in development funding of the 1980s, when the World Bank's concerns with how to finance development saw cost-effectiveness as key to investment justification, impacted WASH. The World Bank's prioritisation of programmes shifted from locating finance where disease burden was greatest to funding interventions with proven cost-effectiveness, set out in the landmark World Development Report in 1993.[28,112] Since 1990, JMP has tracked progress on global goals in the WASH sector, thereby guiding what counts as success. While the JMP, the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) report and other monitoring tools have been analysed in terms of methodological strengths and weaknesses, less attention has been given to the political work entailed in the universalising and depoliticising impetus in setting and tracking global standards. The inclusion in metrics of not just *what* WASH policy is implemented but *how* governments are implementing – such as institutional leadership, capacity, monitoring – mirrors broader 'good governance' agendas that aim to influence the organisation of public policy in pursuit of achieving the

desired outcomes. In the following, we explore examples of how the sector has framed successes and recent 'failures' (or lack of evidence) and the political work global metrics perform.

Millennium Development Goals (MDGs)

The MDGs (2000 – 2015) reflected a drive for multi-dimensional development metrics with quantifiable monitoring and evaluation. A concrete and measurable target was set – belatedly, after lobbying – for WASH, to "halve the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015."[113] Indicators needed to be simple and standardised proxies – such as the broad category of water source used by a household – without the more complex technical details – such as whether the water source in question was contaminated or provided a continuous supply over time. To compile systematic evidence for the countable indicators, the top-down approach of government engineers answering WHO surveys was replaced by more user-generated data collection through statistically representative household surveys or population censuses. Measurement was characterised by principles of transparency, accountability, audits and conditionality, mid-term reviews and evaluations.[27]. Since the 2000s, also in WASH, the substantial time, money and other resources given to monitoring and evaluation has been questioned for its achievements in supporting 'accelerated development', its value for money[26,27] and whether a focus on greatest need is outbalanced by targets focusing on greatest effectiveness.[28]

The use of universal, and focused, indicators in global governance creates a form of knowledge production that reconfigures power relations between rich and poor nations and between governments and civil society; (statistical) measures obscured debates over political priorities with technical expertise.[114] Those working in WASH were uncomfortable with the simplified monitoring indicators such as 'improved water sources' that led to the mistaken conclusion that the MDG on 'safe' drinking water (itself a vague and difficult to measure term) was achieved, overlooking water quality, quantity and differentiated access across gender and class within 'successful' countries.[115,116] Critics argued that low-income countries, especially in Africa, were labelled as 'failing' or 'not on track', because although drinking water access did improve, the improvements did not meet the universal bar set by the MDGs.[117] Thus the objective measures constructed as policy-relevant facts can be seen to result from intense struggles for political and epistemic authority.[118] The sector has therefore had to grapple with the work that indicators perform, which can be traced by asking what aspect of reality they reveal, distort and conceal.[119] As the history of monitoring in WASH attests, targets are prone to a wide variety of interpretations,[27] and how things are measured can mesh with other monitoring instruments, and different types of evaluations show different perspectives.[29] A widely employed strategy to solve the lack of evidence – or to fill the gaps – is to develop more indices, or design more complex M&E frameworks, which add to the burden of data collection and further disincentivise investment outside of the indicator frame.[27]

The Sustainable Development Goals (SDGs)

In 2016 the MDGs gave way to a new set of global priorities set for 2030 called the Sustainable Development Goals (SDGs). These were accompanied by the call for disaggregated data and more specific measurements and indicators, the focus on 'metricisation' gained even further momentum. The rise of indicator or audit culture connected to an amplified form of evidence-based governance.[120,121] A clear shift took place in WASH from the creation of a single target that guided the measurement of progress on access to improved water, towards the broad, human-rights informed SDG6 that called for a broader range of targets (Table 2), each with composite numerical indicators. The more overtly political, rather than narrowly technical, targets – and 'means to achieve' them – has led to major measurement challenges.

While metrics and numbers strive to convey objective truth and scientific validity – and they are appealing because they allow for comparison and appear to stand above politics – they also risk hiding the interpretive and political work that goes into creating and measuring them. They may overlook

crucial dimensions of social life that fall outside of these indicators and categories. Complex social processes such as water access and gendered vulnerabilities cannot be reduced to binary and essentialising categories as typified by the bulk of epidemiological evidence. For instance, data on the relationship between water access and child health omits information about the health of mothers who fetch the water.[13] Global water metrics that indicate safe access can mask challenges in adequate water quantities & quality as attributes are often highly variable with respect to community socio-demographics or political affiliation. Even piped water may not offer protection at the point of use or when water is stored in containers;[122] when piped water is intermittently delivered, for example, it is more easily contaminated, and (usually) women still need to wait, collect and store it. Finally, only what is considered measurable and countable by the scientific community does not always align with what is valued and needed by users locally. This has precipitated concerns about what should be monitored and on whose terms.[27,123,124]

Scientists' Metrics

The nature of scientific attention to the measurement of WASH has changed over time. Broadly, a shift occurred from a generalized assessment of needs and solutions to more narrowly defined measurements of success with the increasing deployment of trial designs to quantify health impacts with greater precision, to a re-broadening of 'what works' questions in recent years.

Frameworks and indicators for evaluation emerged in the 1970s, aiming for a wide-angle lens to capture the multiple dimensions and impacts of water and sanitation programming.[70,125] Taking as a starting point that much investment was being made into programmes that were deemed ineffective, researchers provided guidance for the multiple parameters that must be assessed and synthesized to understand impact, including technical, administrative, health impact and village level evaluations.[108] Specifically for health impacts, various study designs were offered that could be used to establish effects and interpret results – including of negative findings.[126] By the 2000s, with the paradigm of evidence-based programming now gaining pace, randomized controlled trials (RCTs) were solidified, beyond health research, as the gold standard for robust evidence of impacts of interventions. The pinnacle of these designs was the double-blind placebo-controlled randomized trial, able to create evidence in the most objective way – free from most biases and interferences of human behaviour. This highest quality evidence – where quality is understood as being of risk of bias - was perhaps achieved in the evaluation of point-of-use water treatment interventons where placebo trials were conducted. Whilst three such trials in the Gambia, Brazil and Ghana failed to show any impact on diarrhoeal disease,[127] scientists debated the validity of these findings when compared with a wider body of evidence from studies that were deemed to be of lower quality but that had shown significant effects of these interventions.[128] Such debates reflected wider concerns that the required focus for trial design traded off external validity for internal validity, constrained the questions that could be asked about water and health, and reduced the ability to engage with the complexity of such interventions.[129]

The move towards RCTs in the quest by some researchers, funders and research-users in policy positions for definitive evidence of effects involved two scalar shifts: first, the narrowing of the definition of effects to a primary outcome with a set of secondary outcomes; second, the narrowing of intervention possibilities to those that could be randomized to individuals, and later small clusters.[130] Implications of the former for WASH included a need to prioritise primary and secondary measures of effectiveness of what might be a multi-faceted programme with multiple impacts. Implications of the need to individualize interventions can be seen in the nature of trial evidence: technological devices, washing apparatus and behavioural messaging delivered through home visits. The lack of expected impact on child stunting and diarrhoeal outcomes of such interventions in the large SHINE and WASH Benefits trials led investigators to question both the choice of outcomes and whether broader programmes would have been more impactful.[5] It also increased the attention to

the reliance on RCTs as the gold standard, rather than high quality observational study designs and implementation science methods that may be more amenable and cost-effective for addressing critical sectoral questions.[131,132]

The evolution of WASH as a sector has increasingly called for the expansion of outcomes and associated indicators, but the increasing metricisation underpinning evidence-based policy does not overcome its technocratic tenets that neutralise ideologies and make power relations seemingly irrelevant.[133] The metricisation trend and debates arising around the interpretation of trial findings can be understood as a form of sense-making within a domain of 'uncomfortable knowledge,'[34] which we discuss further below.

Discussion

Over the last six decades, WASH has emerged and co-evolved with wider paradigms in global health and development. By bringing to the fore orientations that we recognise to have shaped the WASH sector – technicalisation, universalisation, responsibilisation and metricisation – we have illustrated how the sector's foci, successes and challenges relate to these shifts in science, politics and economics over a period characterised by increasing globalisation. The stabilization of WASH as a sector, such that it has been able to articulate a series of global goals, to establish funding channels and to measure improvements in peoples' lives around the world, has also meant that alternative ways of knowing, curating and counting water, sanitation and hygiene efforts have been overlooked. We argue that this has produced a milieu of 'uncomfortable knowledge' – the knowns that have had to be unknown – through which actors in the sector are navigating. This paper has described key influential commitments that have led the sector to this juncture; those navigating the next stages must now decide whether to continue to follow the same points of orientation.

One potential consequence of aligning the efforts of a sector with the broader prevailing paradigms of global health and development is the possibility that important instrinsic aspects of that sector may become obscured. The commitment to universalisation, advancing Western blueprints for development, has risked overlooking questions that mattered locally around equity of access, but also around management and maintenance, governance, institutional capacity, accountability and sustainability. It also risked masking the organic links between WASH with other development issues, such as housing and urban planning. Informed by the responsibilisation agenda, the focus on community management, appropriate (uptake of) technologies and behaviour change has overlooked the complex and lived (and gendered) experiences of poverty, including for example what 'affordability' of water really means[6] as well as the precarity of living conditions in water-deprived environments. Global efforts to create targets through metricisation have paid insufficient attention to the political choices implicated in creating and measuring global indicators and what is valued locally, the unpaid labour that is required to adhere to such measuring protocols on the ground and to the power asymmetries and dependencies sustaining such efforts. While evidence-based policy is a way to prioritise and legitimize certain policy options over others, Saltelli et al point out that it can also produce its opposite, "policy based evidence" [which] "may also lead to a dramatic simplification of the available perceptions, in flawed policy prescriptions and in the neglect of other relevant world views of legitimate stakeholders."[133 (p62)]

What is perhaps less obvious is the degree to which a sector such as WASH becomes written-in to the scripts of these wider paradigm shifts, such that these ways of knowing, characterising and counting problems, and of responding to issues as thus characterised becomes self-evident. We can observe that over the decades, those working within the WASH sector have had to incorporate multiple

competing understandings of problems and solutions, noting for example tensions between 'the field' 'on the ground' and 'the sector' as a global object that in its construction requires compromises in order to continue momentum. Whilst this produces known unknowns – as noted above – it also raises the possibility of unknown knowns: 'what we don't know that we know.'[34 (p108)] Rayner describes the often tacit but active exclusion of knowns by societies or institutions 'because they threaten to undermine key organizational arrangements or the ability of institutions to pursue their goals' (ibid). Such 'social construction of ignorance' (ibid), of knowledge that is in tension or outright contradiction with self-consistent and simplified versions of reality that have been developed in order to act in a complex world, is apparent in debates around metrics and trials in WASH – in the interpretations of what works and for whom, and how we can know this. The resulting 'uncomfortable knowledge' that WASH actors are living with emerges not only through the processes of metricisation but at its intersection with technicalisation, universalisation and responsibilisation.

A persistent known unknown in the evolution of the WASH research and policy literature is attention to the role of gender in WASH provision and in the impacts of (in)adequate WASH. The absence of gender in accounts and reports reviewed for this paper was notable. Recent work has tried to live up to the "special attention" to the needs of women and girls as called for in SDG6, especially with a gendered understanding of physical and mental health with respect to sanitation and menstrual hygiene.[96,134] But mainstream health policy research, through the instrumentalization of women and the undervaluation of their labour, continues to undervalue the benefits (and costs) of safe water for women, despite acknowledging their "central role" in providing and protecting water.[13] Where gender intersects with other marginalities such as race, caste, indigeneity or disability, the policy literature is even more silent.[135] The discourse of "transformative" WASH has yet to transcend these blind spots.

Our intention is to support a re-imagining of the WASH sector by providing a source of reflection on its evolution. The observations in this paper raise questions about the forms of scholarship, knowledge and science that have been privileged in the assemblage of the global WASH sector, and what forms of power asymmetries and dependencies may have been overlooked and reproduced by such knowledge formations. Such observations, driven by a social research approach to the construction of the sector, perhaps differ from the traditional view of the roles social scientists can play in WASH. Traditionally more instrumental (often lamented as 'handmaiden') to the existing natural sciences schemata that were already stabilised, social scientists have been tasked with answering questions such as 'how can we change behaviour?' rather than to critically scrutinize the objectives and consequences of such endeavours. A similar shift within engineering (education) also occurred over the sector's first decades when it increasingly narrowed down to technical questions detached from societal ones.[55] This fate has befallen the public health sector as well, which over time became a technical shadow of its own comprehensive beginnings[31] and is confronted with the challenge now of how to transcend an increasingly narrow technical public health ideology.[121] This leads us to articulate similar questions about regional expertise and the forms of knowledge and power that have come to set the norms, priorities and shape ideas of success in the sector. Pertinent questions include: to what degree has the field of WASH been defined by actors in the Global North? How might this change without falling into the same instrumentalisation trap that invites 'other perspectives' only to sustain the same kinds of relations? What would a decolonisation of the field actually look like and from where might the appetite for this emerge?[14,15] What forms of concern with drinking water and management of human waste could emerge if the particular assemblage of science, power, processes and people that currently defines WASH were decentred, and more prominence was given to the knowledge, experiences and ideas of success as defined outside of these structures?

Conclusion

The emergence of WASH as an international field of expertise and practice is a story that is not unique to this sector. The global forces at play that define how health, development and health science are done have far-reaching impacts on the shape of sectors at national, regional and local levels of implementation. For WASH, this has entailed the creation of a sector largely underpinned by parallel tracks of technically based disease control and engineering foci – albeit with a relatively small professionally trained cadre – that has resulted in a depoliticization of poverty and social inequalities, and a focus on particular outcomes and objectives, through neutralising agendas of universalisation, responsibilisation and metricisation. The uncomfortable knowledge that actors in the WASH sector may encounter is amplified in this moment of increased concern about colonial legacies, shrinking health and development budgets, gender disparities within and across communities, and yet heightened awareness of the importance of WASH as the COVID-19 pandemic and climate change continue to disproportionately affect LMICs.

Appendices

Appendix 1. Background and expertise of interviewees

Appendix 2. Topic guide semi-structured interviews

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Boxes, Tables, figures

Box 1

UN Sustainable Development Goal 6 to "ensure access to clean water and sanitation for all by 2030"

6 "outcome-oriented targets"

Target 6.1 and 6.2 specifically pertain to Water, Sanitation and Hygiene (WASH)

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3 Improve water quality, wastewater treatment and safe reuse
6.4 Increase water-use efficiency and ensure freshwater supplies
6.5 Implement Integrated Water-Resource Management
6.6 Protect and restore water-related ecosystems

The two "means of achieving" targets
6.A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6.B Support and strengthen the participation of local communities in improving water and sanitation management

Box 2: Key themes characterising the assemblage of WASH as a health and development sector

- **Technicalisation:** WASH developed in parallel with other health and development issues of focus in the twentieth century that can be characterized as problems solvable through science, technologies and economic justification.
- **Universalisation:** The evolution of WASH was shaped by the development sector's drive for universal solutions that can be deployed through travelling blueprints of infrastructure, aid and assistance.
- **Responsibilisation:** With the rise of new multilateral and non-state actors, around the 1980s, the WASH sector joined the wider health and development communities to emphasise participation and empowerment, moves which increasingly morphed into a passing-on of responsibility to those least able to act, informing rationales for behaviour change solutions and user-fees for basic services.
- **Metricisation:** Across health and development fields, metrics – including in WASH – have gained power beyond understanding the scale of problems and performance of interventions. Since the MDGs, evidence-based international health programming has seen metrics define the parameters and nature of problems, being trained on aspects that are solvable and evaluable through forms of measurement, monitoring and auditing under a rubric of aid efficiency (cost-effectiveness, value for money), good governance (accountability) and good science (evidence).

Figure 1: WASH as a Global Assemblage: themes and examples

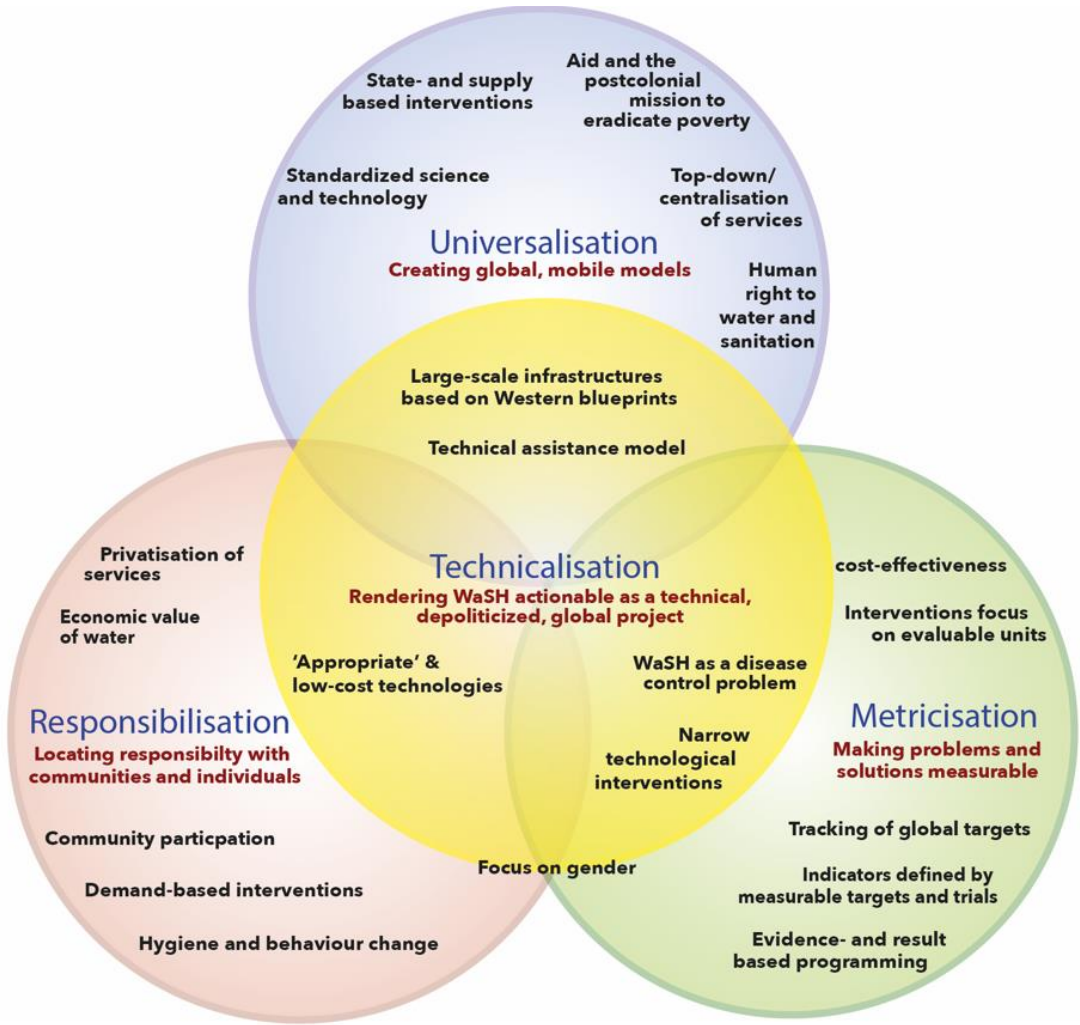


Figure 2: Timeline of key shifts in ideological orientations in the WASH sector

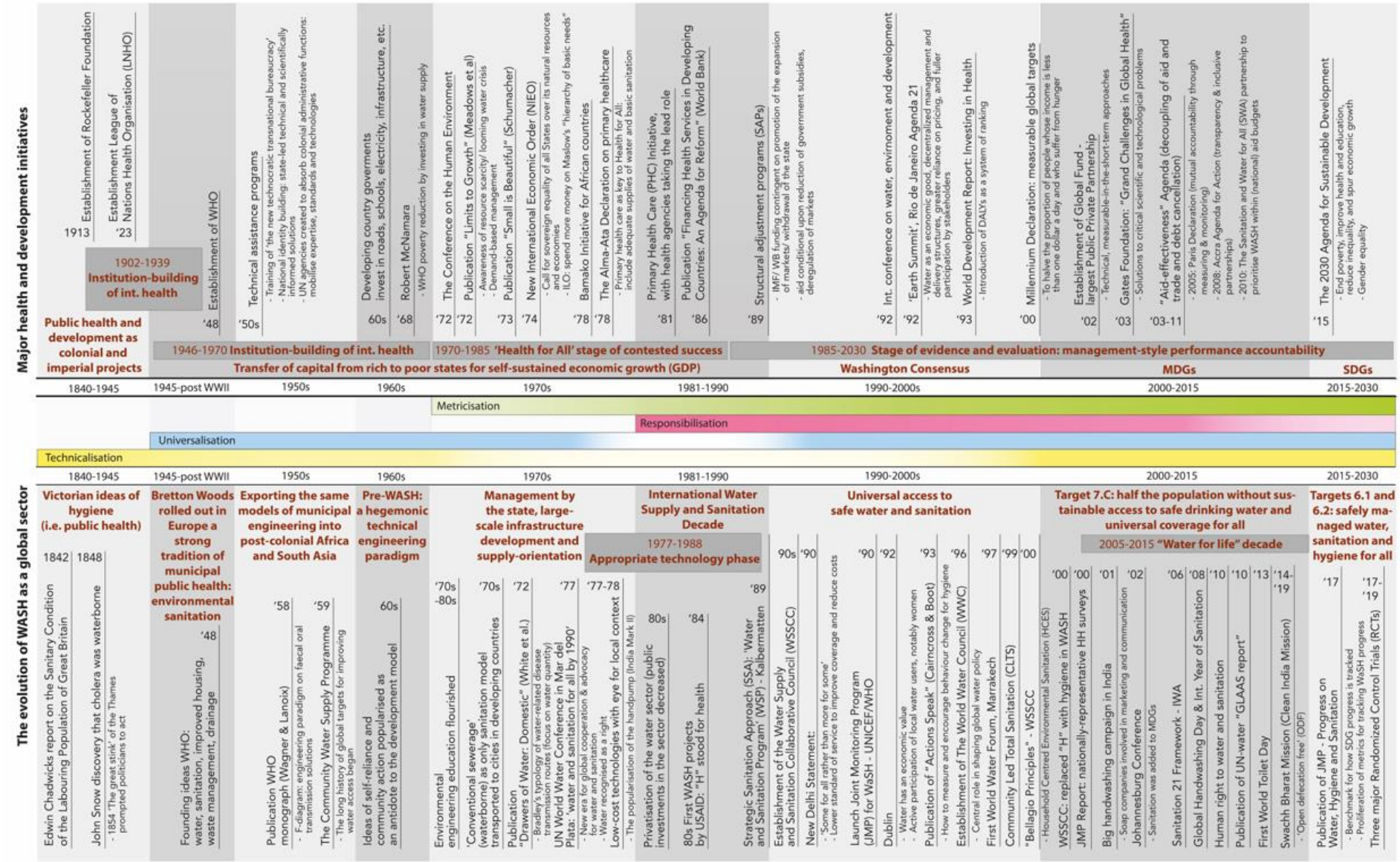
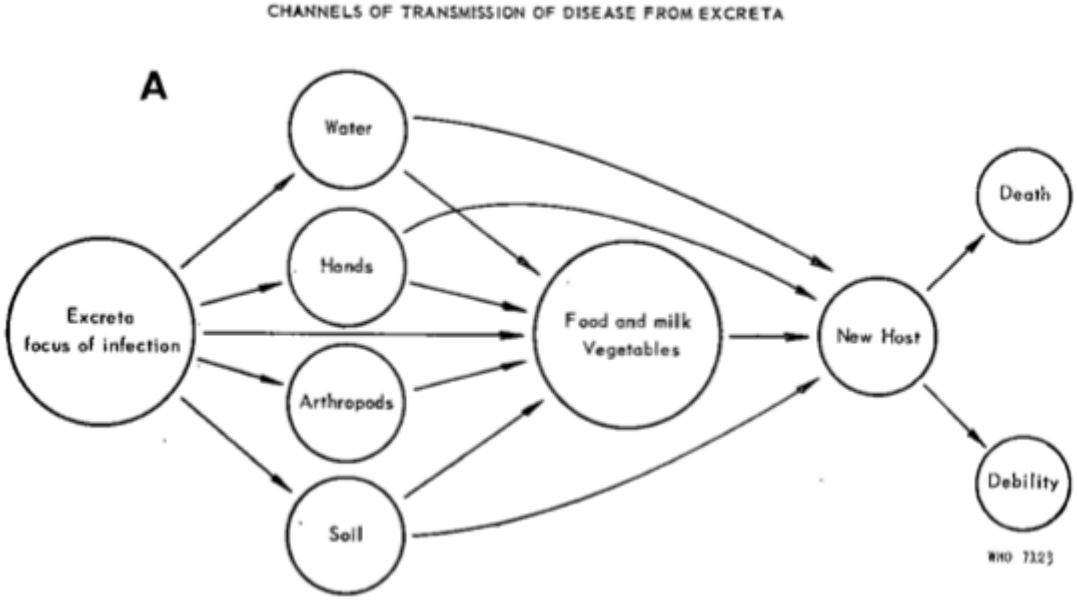


Figure 3. F-Diagram – Faecal oral transmission of pathogens and main ways to break the transmission route



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