Services and Slums: Rethinking Infrastructures and Provisioning across the Nexus

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Nexus Network think piece Series, Paper 004 (April 2015)

About the Nexus Network think piece series

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Introduction

This piece contributes to the debates and research concerning the structural and infrastructural challenges facing contemporary cities in the Global South, by focusing on the diverse geography of 'slums' and their inadequate forms of provisioning. In these urban contexts, a nexus approach is most useful to reposition and contextualise the tight linkages between four critical spheres of provisioning: Water, Food, Energy, and crucially, Waste. Unplanned and makeshift infrastructures in slums have resulted in particularly close spatial and practical intersections of water sources, urban agriculture, food preparation, access to off-grid energy, as well as waste streams and open sewers. There is a compelling case for extending and challenging current directions of the nexus literature through reviewing past and present opportunities in rural and urban slum spaces *across* the resources spectrum of energy-water-food *and* waste. Considering that this think piece is an intervention in its own right, we also emphasise the importance of better integrating the narratives and experiences of communities *depending on* services. This includes perspectives on traditional and alternative providers, especially where formal or recognised institutional support is irregular and unreliable.

In the shadows of rapid urbanisation and economic liberalisation across the world, the formation and demographic growth of informal settlements or 'slums' far outpaces the availability and capacity of urban planning[1]. As a result, the majority of the urban population in cities and towns live on a fraction of the city's land, form part of an irregular economy, and are marginalized by the state. Particularly when it comes to basic service provision, a form of 'malevolent urbanism' has generated across urban areas in the global South, where unequal access to and use of the city is prevalent[2]. At the same time, a mosaic of actors, sectors, and initiatives seek to address the "challenges of slums"[3], usually purporting to work *with* local communities, but often misunderstanding how everyday practices and expectations might differ from externally defined development goals and impact measures. The myriad upgrading efforts that have taken place in the last decade have tended to address individual problems with individualised, technical solutions[4]. In relation to basic services, there are NGOs and intergovernmental efforts focused on improving water access, different sectors focused on sanitation poverty, social enterprises working on off-grid solar lighting distribution, urban agricultural initiatives focused on food security, and community groups and companies taking charge of waste-picking in the absence of municipal services. Rarely do these different efforts

converge, and yet within tight-knit "slum ecologies"[5] each component on the water-food-energy-waste nexus affects the other.

This piece is structured in four sections. **Section A** focuses on identifying the gaps within the literature on provisioning to slums. This includes making a case for how these environments give form to a lived geography of a 'nexus of services', alongside conceptualisations of nexus as a *process*, that is, as a grounded approach replete with integrated sectoral understandings and alternative management potentials. Herein, we establish the case for bringing together an expanded conceptualisation of nexus thinking that includes waste and the urban literature on slums. **Section B** reviews the literature on slums to highlight issues concerning *scale* and *seasonality* in order to emphasize the heterogeneity of slum spaces and the challenges of provisioning to areas that experience constant shifts of in- and out- migration, climate extremes, and intra-slum disparities around access to goods and services. We review how slums have been officially defined and 'managed' by intergovernmental agencies, governments and civil society actors, which we complement and critique by drawing attention to the diversity of slum forms across rural-urban gradations and pertinent factors affecting provision. These include seasonality, labour migration, fluctuating livelihood opportunities, and towns' interconnectivities. We highlight some of the technical terms of analysis and individualised, boxed-in forms of management of individual sectors across water, energy, food and waste. We articulate the distinct advantages and opportunities for how a nexus lens facilitates the re-questioning of hallowed assumptions on the role of the state and market economies in informal (slum) settlements. **Section C** presents selected ethnographic research and accounts of slum neighbourhoods across geographies, providing much-required attention to the coping strategies of communities living in and around slumscapes, and how everyday lives engage with the nexus of water-food-energy and waste. Finally, **Section D** argues for a reappraisal of responsibilities and roles in the provision of services to slum areas, and suggests that there are multiple opportunities for nexus approaches. In this vein, we highlight avenues of potential future research and reflect on methodological applications.

Section A. Identifying The Gaps

Substandard housing and basic services: a price worth paying?

Within urban studies, research and literature on mega-city slums is well established, while much less attention has been paid to their heterogeneity and the existence of small, seasonal or temporary slums that emerge in towns and peri-urban or even presumably rural areas. We address this gap by conceptualising nexus interconnectivities along the rural-urban

continuum. Drawing from our field knowledge spanning the established slums of 'arrival cities'[6], such as Nairobi, to the seasonal 'summer slums' in the small towns of the lower Himalayas in India, we seek to challenge the dominant categorisations of the undistinguished rural, the transient proto-urban peri-urban, and the mega city urban, to highlight the needs and coping strategies and devices of the people living within such areas, and to understand the 'lived' form as well as opportunities for Nexus approaches to services' provisioning. As such, we conceptualise infrastructural and provisioning across the nexus along the complex gradation of rural to urban: from the very rural, to the seasonal settlements in rural places, to small towns constrained in size that tend to remain small, to transient towns on a trajectory of rapid growth and urbanisation, to the mega city experiencing sustained, though not necessarily sustainable, modes of expansion.

The nexus may be conceived as a concept with an inherent geography and a definitive urban bias. States may more efficiently provide and cater to clustered populations living at high densities, as this leads to a positive economy of scale in provisioning and infrastructure related to energy, food and water. In contrast, rural areas with spread out, sparse populations offer lower returns on infrastructural investments; politically, power, control and votes have been easier to harness when populations inhabit settlements situated densely in the landscape[7]. Decreased government spending and support to rural areas world-wide, with the subsequent lack of maintained infrastructures, new investments or opportunities actively incentivises rural-to-urban migration. Alongside governmental (dis)incentives, whether active or passive, the market viability of traditional, typically low-input, variable yield agricultural forms combined with changing opportunity structures and the rapid abundant availability of goods even to rural places provides further impetus for livelihood diversification in rural and urban areas alike, and are responsible for large movements of people to more urban settlements. In this way financial, managerial and technical efficiency dictate that nexus approaches may go hand-in-hand with urbanisation processes. In practice, there is also a lived geography of the nexus, where the clustering or widespread proliferation of slums affect the ease of provisioning, with expanding peri-urban areas tending to be a greater distance from clean water and with poorer sanitation[8]. Slums that are located at the periphery of the city, with little or no tenure security, political patronage or 'protection', are consistently under-serviced relative to better-located, legally and/or politically acknowledged low-income settlements[9;10].

In most slums, owner occupation is rare, so the incentive for tenants to invest in basic services is low given their insecurity of housing. In Nairobi, for example, landlords themselves rarely live in their own rental blocks, which is one of the many reasons why negotiating

infrastructural improvements is such a challenge. Much of the low-income real-estate market is unregulated, bypassing legal restrictions on modern building and zoning regulations, and perpetuates existing social segregation and uneven development of cities. Slums can be, from the landlords' point of view, a lucrative but risky investment. Seeking a return on their investment, landlords have to contend with risks of high tenant turnover, mobility, and rent default. The primary motive is purely profit-driven, "maximisation of capacity", and health and safety concerns of urban planning requirements are by-passed to the extent that in Nairobi, 64.4% of households share a toilet with another household[11]. In Mumbai's Slum Sanitation Programme, one toilet seat for every fifty people is considered adequate[12]. Furthermore, while tenement blocks are typically "on the grid" as compared to the horizontal "illegal" shacks, the frequency of black-outs and power outages makes the everyday highly volatile and unreliable for all residents across the income spectrum living in and around informal settlements, and particularly so for women, who predominantly contend with water and hygiene shortages[13;14;15].

Although on the one hand slum housing parallels Engels' description of industrialising Europe with its high degree of "exploitation and oppression of the working class by the ruling class"[16], the current wave of urbanisation sweeping the 'Global South' – referred to herein as "second wave urbanism"[17] – 21st century tenants are "urbanising households in need of mobility and convenience as they enter the urban economy" (Reference 11, p. 7), and are prepared to deal with the environmental and health risks associated with unplanned and rapid urbanisation, because "life in the slums" is perceived as a better alternative to rural poverty. In other words, "arriving" in the slums is already a feat[6]. Dealing with sub-standard housing and access to basic services is the price and risk tenants are prepared to pay in order to reside at every point on the urbanisation chain linking the rural farmland to the megacities, for its proximity to labour, trade, networks, education, and communication opportunities. When it comes to addressing inadequate living conditions in slums, current intergovernmental and private providers as well as inhabitants may evoke "the state" as bearing the responsibility, legitimacy and the long-term financial capacity for investing in such infrastructures and needs. However in practice, everyday services and infrastructures are maintained by a variety of local private providers, community based organisations and often the result of alliances between NGOs and local groups working towards incremental solutions and upgrading schemes. These various stakeholders approach provisioning with different philosophies and motivations[18]. We unpack and highlight the paradox of normative claims made by provisioning agencies as well as slum inhabitants *vis-a-vis* the state in contrast to the coping strategies on the ground that reflect a lack of expectation *from* the state. In the following

sections, we first examine this tension by considering different examples of slum scale and space across regions of the Global South. We then suggest, in turn, that Nexus approaches proffer points of development and empowerment to local stakeholder groups that are more engaged and vested to see improvements in slum spaces, which promises a fruitful point of engagement as well as a forward path.

Section B. Slum Scales and Spaces

The 'second wave of urbanisation' taking place in the Global South has transformed the role and composition of urban settlements, with a rise in urban populations from 309 million in 1950 to an projected, unprecedented 3.9 billion people by 2030, of which the informal urban population will be approximately 3 billion world-wide, representing a trebling of slum populations from today[19]. Urbanisation in Africa, Asia and Latin America continue to be strongly associated with the expansion of existing and the formation of new slums, wherein structural poverty and deep inequality in the access to resources, housing and labour opportunities are typical characteristics of the 'everyday' living factors and conditions in these settlements.

From our reviews of intergovernmental reports and literature, slums are most commonly defined as urban housing forms with significant 'shelter deprivations', where housing infrastructures are of poor structural quality, land tenure recognition and rights are non-existent, and where basic services' provision is wholly or partially inadequate; they are depicted as the outcomes of inadequate planning and a denial of social and infrastructural services' provisioning from the state. 'Slums' are also frequently termed 'informal', 'marginal' or 'shantytown' settlements[20;iii] to reflect their illegality or lack of compliance (or complete absence) with planning and tenurial laws. 'Informal' may have a wide range of meanings, referring to a complete absence of regulation or planning law, or the direct evasion or breaking of such laws where they exist. 'Shanties' are "crudely built shacks" frequently made out of cardboard, "hastily thrown up" on the "outskirts" of towns, unable to withstand the elements[19], implying a limited and limiting temporality to these forms of city dwelling. In contrast, 'camps', 'makeshift' or 'temporary housing' are the only terms found in the intergovernmental literature that reflects the impermanent natures of some settlements, particularly associated with refugees or the internally displaced[21], with no official definitions of large-scale movements in- and out- of slums. The use of the term "squats", lived-in by "squatters" who "frequently have to endure worse conditions than their rural relatives"[22] further emphasises the 'illegal' nature of land occupation with temporary housing

arrangements with contested legal title, as compared to (some) slum-dwellers in slums[3]. Squatters as "pirate urbanism"[5] have received significant academic attention, or as occupancy urbanism, whereby the "urban poor assert territorial claims" in contexts where they are otherwise denied or ignored[23]. Understanding the processes and lived realities of slums allows a relative, grounded approach to their conceptualisation, to re-contextualise the somewhat exclusionary and isolationist branding of low-income settlements as 'no-go zones', 'garbage slums', 'slum islands', or as 'dominating the cityscape'[3;20;21], to an understanding of how these different forms of urban life and fates interrelate, and how solutions to deeply inadequate provision may be overcome in creative ways.

Articulated 'shelter deprivations' are defined as a function of inadequate water, sanitation, durable housing and insufficient living area, with slum dwellers distributed across slum types measured as having one or more of these deprivations [3;20]. All these measures refer to physical attributes of the slum, with one further deprivation, the (in)security of land tenure, a question of *de facto* or *de jure* legality of the household or slum area [20]. Countries are at significant variance with the socio-economic composition and geographic spatialities of their slums, with three general typologies categorised and quantified by UN-Habitat[24]: first, slums where both the rich and poor live side-by-side, with few non-deprived areas of cities and towns; second, distinct slum settlements forming a part of capital and larger cities only; third, non-slum areas as predominant across cities, with high- and low- income families. However, although slums are depicted as increasingly ubiquitous in the developing regions of the world, there has been little recognition of the variability of their sizes and compositions, inter- and intra- city relations and the heterogeneousness of their forms. Challenges and living conditions are not identical across all slums and scales; indeed, slums in smaller cities and towns tend to consistently bear a greater number of shelter deprivations, particularly around improved water and sanitation, while larger cities' and capitals' main shelter deprivation is overcrowding and insufficient living space, leading to skyrocketing land prices as a response to inadequate housing options, particularly in Sub-Saharan Africa2020[20].

In recent years, there has been a densification of many existing slums at the same time as outflows of poor people from city centres to their peripheries in response to rising land prices in city centres, leading to expansive 'peri-urban' areas[25;26]. Such trends and people flows support a conceptualisation of urbanisms along an urban-rural continuum with a plethora of links across space and terrain, rather than a sharp divergent binary of 'haves' and 'have-nots' frequently emphasised when urban inequalities are described[27]. The ability to capture and formally assess the heterogeneity of different urban forms and sizes is limited by census data

collection techniques and pre-existing categories that fail to disaggregate urban areas' types and scales[20]. Frequently, national-level categorisations of settlements as 'urban' or 'rural' pre-define funding availabilities and administrative forms and levels, masking a highly strategic or political process that fails to meaningfully reflect differences (if they exist at all) between large villages, small and large towns and peri-urban spaces when it comes to their features, available infrastructures, insecurities of land tenure or the obstacles they face in services provisioning. Classifications 'count' as electricity and water provision are more likely to be addressed when settlements are classified as urban[20].

Slums are prevalent across both small and large cities, and in Africa, are more preponderant in small cities; the political economies, connectivities, agencies of its people and the defining roles of towns and small cities thus become crucial for understanding the possibilities for better services' provisioning to a multitude of slum types and scales across rural- and urban-like agglomerations. Stemming from the spatial heterogeneity of slum forms, and in some cases underpinning the form itself, are the factors of temporality and seasonality. Snapshots of slum life through census or Demographic and Health Surveys (DHS) fail to capture the transient nature of labour and livelihood opportunities along the 'slum scale', wherein seasonal opportunities arising from agriculture or tourism result in significant out-migration or the establishment of small, seasonal slum settlements. This has meaningful consequences for provisioning: first, it makes it more difficult, or requires planning that is attuned to peaks and troughs in demand. Second, high turnover rates of residents, or the temporality of slum-dwellings may also result in lower willingness to invest and maintain facilities and services from behalf of residents[28]. Slums across scales are marked by shifting forms of spatial mobility linked to the seasonality of human livelihood opportunities in rural and urban contexts. There is also a myriad of migration types that directly affect the forms and permanence of dwellings: camps and shanties may exist only for the summer tourist season as poor labour seeks to service a temporary tourist influx; alternatively strategic, opportunistic migration as linked to seasonal labour in the surrounding countryside mean that absences from slum-like settlements are particular to gender at particular times of the year, further necessitating year-round education, health, waste and water requirements to non-labourers in these households. In this way, labour and seasonal migration are intimately linked, as urban migration is often tied to the cycles of rains and harvests in the farming economy. People seek alternatives to agricultural work "when the rains cease and the harvests are in, and then come back to work on their families' farms when the rains return"[29], or, "when the urban economy takes a plunge... large populations of tentatively settled workers move back to their home villages" (Reference 6, p. 38). Furthermore, migration is not only a function of the urban and

rural, as high proportions of international remittances increasingly influences and enables alternative livelihood strategies of the 'left behind' urban poor[6].

Less evoked in the literature is *intra-slum* spatial mobility, due to the vicissitudes of incomes and the variable rents within a single low-income neighbourhood. While much of the urban poverty debates frequently focus on the "horizontal", which are single story shantytowns comprised of makeshift shacks, open sewers, and absence of public services of any kind, the so-called "insecure, informal settlements of the poor"[3] also include multi-story private rental or "tenement" blocks alongside the 10 by 10 shacks[11]. Depending on where the structures are in the slum, rent prices may vary considerably[30]. The cheaper the rent, the more hazardous the location tends to be at every level of the nexus (e.g. closest to the river and at risk of flooding, farthest from roads, potable water sources, public toilets, and the electrical grid). Migration forms a key role in economic activity and mobility[31]. Depending on how "rich" or how "poor" a household is in a given month, households may "upgrade" or "downgrade" their living conditions accordingly. So as people's spatial mobility may be tied to the seasonality of livelihood opportunities in rural versus urban areas, it is also influenced by the relative variation within their expected income generating patterns. For some tenants, the city may be a place of "transience", for others it has been an "arrival city" for decades[32]. There are therefore internal and external structural, social and economic factors influencing the dynamics of unregulated housing development, shifting tenancy, and the persistent demand for low-income housing in the absence of planned public housing. And as local municipalities tend to be increasingly inadequately funded, resourced or managed to assume their role and address city-wide municipal services and planning regulations, the tenement "typology" alongside the makeshift slums have become the status quo amidst the growing "urban form" of cities across the global South, especially Africa (Reference 11, p. 8). These variances form the basis for the various 'coping strategies' employed for day-to-day life in slum areas, explored in Section C, which better reflect the spatial and experienced overlaps and interdependencies between needs and services' provisioning. These run counter to the siloed provisioning approaches to management to date, outlined in the section that follows.

Siloed provisioning and 'decentralisation'

To date, the interrelations and effects of one service sector upon another have not been meaningfully integrated. The practice of approaching services' in an individualised, technocratic form highly reliant upon engineering solutions and expert knowledge reflects institutional and management overlaps and incoherencies between sectors that are not required or in the habit of communicating, whether across governmental ministries,

departments or donors[33;34;35], and indeed, is valid across the services' spectrum, whether for waste, water, food or energy.

The food sector is particularly replete with the "potentials" and "futures" of composting, along with the use of human waste as fertiliser and wastewater for irrigation[36;37]. Approaches to municipal waste tend to be fairly technocratic in provision and analysis, ignoring the overlapping effects of waste on water, sanitation, food and health, with emphasis on the lack of political will and finances for operationalising an effective waste management system[38;39], but one that does not explicitly address these interdependencies. Consequent to a lack of funds and communication strategies or data streaming between government agencies, waste disposal and management options have largely stagnated and failed to evolve to address new needs and waste forms[33;38].

Siloed institutional responsibilities and attitudes may also be linked to the significant challenges nexus approaches face when attempted in slum areas. In place, on-the-ground distinctions between formal and informal blur, with many calls for the formalisation of the informal[40], and (governmental) regulation to increase the access of the poor to water and improved sanitations, for example[41]. However, formality of services' provision is frequently secondary to the need to acknowledge and grant formal land tenure or land rights to slum inhabitants, which are particularly pertinent to growing food in smaller towns and peri-urban areas[42]. For example, Eaton and Hilhorst[43] refer to their work in Mali and Burkina Faso to argue that pre-existing or bottom-up nexus approaches to provisioning can be compromised by insecurity of land tenure. In their case study, they demonstrate that although farmers at the peri-urban interface in Bamako and Ouagadougou use solid waste as compost, land tenure insecurity explains the lack of incentive to safely dispose of the toxic, untreated waste. The case study also argues that any up-scaling or commercialisation of composting in these two cities would inevitably price out local farmers for whom the compost would become too expensive. Herein the pragmatism of operating within the informal economy becomes clear, as engaging in 'illicit' networks of waste trade poses less risk than formalising, and upscaling despite dominant logics that would presume otherwise.

Authors exploring potential innovation in water provisioning in slums in developing regions have tended to emphasise either the importance of investing in decentralised water provisioning systems[44] and/or the imperative to provide support for those working in the informal sector through the development of micro-finance programmes, run by the state or by non-governmental donors[45]. Water management is siloed not only in management practice but

through theoretical or academic debates around its so-called 'neoliberal' privatisation, which refers to the introduction of pricing schemes for water access, use and treatment, which increases the cost of the resource while potentially making it inaccessible to the poorest citizens[46;47]. Most critical discussions and research on neoliberalism reduce the factors and debate to privatisation and costings processes, as well as the (frequently assumed) withdrawal of the state from the primary provisioning role. However, in many contexts the architecture and institutions of states in the Global South, at both national and local levels, are under-funded (or simply do not have the means or basis to raise revenue) and thus are unable to provide the services and investments required to urban or rural areas. Such debates also elide deeper socio-political and economic questions around the structural inequalities around the poor and their barriers to accessing services and amenities like clean water[48]. We develop this point as it connects more broadly to nexus debates and approaches in Section D.

Reflective of the dominant 'siloed' approaches and conceptions to provisioning are the institutional arrangements around services' management, which run parallel to *expectations and normative assumptions* (often unstated or unexplored) around what the role of stakeholders *should* be. For example, widely across the intergovernmental agencies' and academic literatures, decentralisation of services' management is advocated, with a highly fuzzy interpretation and articulation of what 'decentralisation' in these contexts might mean. This is particularly problematic as sectoral divisions are firmly institutionalised, as reviewed above, and vague calls for decentring power and/or devolving control to government and/or private interests are unlikely to focus efforts and opportunities for systemic change. For example, decentralisation may allude to an 'opening up' of governmental decision-making to encourage greater participation and consultations as part of planning processes[49;50], or antithetically, decentralisation refers to the opening up of provisioning management to the private or civil sector, to relieve governments of the costs of providing services[51]. On the whole, however, decentralisation is frequently advocated but unexamined or defined[43;49].

Due attention must also be given to the multi-tiered nature of 'the state'. Across our reviews, local government consistently represents political authority and the opportunity of legitimacy with the confluence of financial resources, power and expertise. In the long-run, political sanction of activities relating to provisioning proves central to the maintenance of current efforts as well as any opportunities or efforts at 'scaling out'[50]. Local government is also "more porous" as it serves as the institutional form that is consistently the 'interface' between inhabitants, with its street-level bureaucrats and local offices the providers as well as the interlocuters and implementers of representations and schemes from higher levels of the

state[22]. The features of government and their localised manifestations also varies across the rural-urban spectral forms of slums and informal settlements.

Smaller slums do not share certain features characterising large urban slums, most notably the congestion and density of people, nor the proximity and links to city centres which enable more opportunities for strong civil society engagements bridging slum community-based organisations (CBOs) and external forms of support, which also provide opportunities for linking small scale and informal businesses to various supply chains enabling access to goods and services, and more opportunities to engage with ICT-based networks for knowledge exchange, information and news. Whilst the urban slums also experience forms of political patronage and oppressive micro-exploitation[52], more permanent, urbanised slums have recourse to greater choices of networks for "mobilising from below"[53] and thus to contest both structural inequalities and slum-based unevenness of access to nexus services. Despite these differences, what ties the rural and urban slum experience in relation to the nexus are the prevalence of social networks and social capital as the dominant albeit informal platform for self-organising and provisioning that determine *how* things get done. Furthermore, urban forms of mobilising and negotiating power relations echoes 'village-like' scales, where in everyday practice allegiances and territorial ties to particular sub-neighbourhoods within large slums are the terrain where people navigate provisioning. It is in fact more common for people living in rural areas to assume longer distances between their domestic spaces and access to water, for instance, than in urban areas[8]. Equally, differential aspects of waste and sanitation are more contested in urban areas where space and tenure are scarce and available at a premium. Highlighting the need and circumstances of rural areas as being akin to the larger urban contexts calls for a rethinking the rural/urban binary when it comes to nexus provisioning, as well as the grounded meanings and possibilities for formal and informal 'solutions' and approaches, which need to contribute to and undergird consideration of prototypical concerns of each context in relation to the other.

There have been an increasing number of calls for a nexus approach to services' provisioning specifically in slums amongst intergovernmental organisations since 2008[54;55]. Far more important for the provisioning in slums are the possibilities for supporting the frequently opportunistic symbioses and working partnerships that may be possible to improve human lives and dignity. What counts is who is able to create opportunities for complementarities, and it is with these considerations in mind that we review current 'coping' strategies and mechanisms from a plethora of intervention forms and stakeholders as services are currently accessed (or not) on-the-ground.

Section C. Coping Strategies

Public urban planning investments in areas stigmatised as economically insignificant or infrastructurally inaccessible[34] have resulted in a vicious circle of "slum urbanism"[18], where the state has, at different levels, been reticent in responding to the growing demands of urban areas where tax bases are low and employment rates erratic. At the same time, the unprecedented rate and scale of the second wave of urbanisation has perpetuated persistent informality, legal opacity, and tenure insecurity in slum settlements, which in turn make these neighbourhoods challenging research fields to navigate, document, and access. As a result, the diverse forms of economic, social, and political activity that takes place in slums go under-documented at a research level and are ignored at the policy level[56]. At the grassroots level, the inherent insecurity of tenure frequently precludes slum dwellers from being able to make legitimate claims for adequate service provision.

Some recent portrayals of slum economies offer reductive narratives suggesting that these neighbourhoods are "traps" with little to no prospects for (economic) growth, upward social mobility, or comprehensive improvements on housing, health, and infrastructure[57;58]. Yet, framing slums as "traps" offers limited possibilities for harnessing the existing strategies and innovative techniques slum dwellers have development in order to cope with what may seem from the outside as insurmountable adversity. "Traps", in other words, offers merely the possibility of survival. There is a more productive conceptualisation of the challenges slum communities face in relation to housing, health and infrastructure, which is urban inequity and injustice in relation to the economic "poverty penalty." The poverty penalty is especially apparent with basic services where poorer households tend to pay relatively more for (and often in absolute terms as well), spend much more time, and risk more in, accessing basic services such as water, toilet facilities, and energy than wealthier households in the city[59;60;61]. What is rarely reflected in the mainstream literature on urban poverty, particularly in economistic depictions, however, is exactly how individuals engage very differently with these penalties.

A growing literature based on embedded ethnographic research takes careful note of the diverse set of survival, mobilisation and makeshift strategies in slum communities in order to overcome resource and service shortages. These efforts reconfigure the relationship between local communities' expectations of the state, as well as the functional possibilities for alternative mechanisms for the provision of basic services resulting from unmet needs. These lived realities are deeply rooted in everyday practice and contingent on social ties, and coping

strategies are often incremental efforts based on improvisation and adaptation in highly adverse conditions[62].

Building on the literature emphasizing everyday strategies and the meaningful struggle against certain poverty penalties, we argue that slums are not mere "traps" where advancement is stagnant, but rather repositories of important experiments that reveal how nexus thinking is operationalised in contexts where there is literally no opportunity to consider the nexus as separate silos. Indeed, across a number of ethnographic accounts of basic service provisioning in slum communities, it is evident that the nexus themes are entangled in everyday navigations of slum infrastructures and ecologies[5]. For example, Njeru[35] writes about the political ecology of plastic bags in the slums of Nairobi, demonstrating how the polythene bag maps across several themes of the nexus as they block drains, which increases flooding in slums, thereby reducing soil productivity, killing livestock if ingested, providing breeding habitats for malaria and releasing toxic fumes when burnt. Misra[63] shows how residential groups in the slums of Bhubaneswar, India, run water pumps and source water from bore wells using the electrical grid. Abarca Guerrero et al.[34] explain that the amount of waste composted in various developing cities positively correlates with waste incineration, arguing that both sets of waste management practices are indicative of coping strategies in the absence of formal collection.

In the absence of state or donor assistance, local residents across slum geographies have formed CBOs or informal associations to develop their own systems of waste collection, composting/recycling and disposal, wastewater monitoring, and water irrigation[64;65;66]. The literature indicates that the potential for these pre-existing, 'bottom up' nexus approaches to provisioning are characterised by two dominant factors: first, the insecurity of land tenure and subsequent lack of long-term investment correlates with practices that pose high environmental and health risks. For instance, in a case study on Mali and Burkina Faso, Eaton and Hilhorst[43] argue that although farmers at the peri-urban interface in Bamako and Ouagadougou use solid waste as compost, land tenure insecurity removes any incentive to safely dispose of the toxic solid waste. Second, the micro-politics of limited and locally contested resources inevitably give way to uneven distribution and access, fraught power relations between those who gain control over the means of access and those who become fee-paying customers. Here there are two forms of potential exploitation at play: the poverty penalty vis-a-vis larger structural injustices and the forms of micro-exploitation and negotiation of resources that may result from political patronage, 'water mafias' or poorly serviced pay-per-use public toilets[6;50;52;67].

Inextricably related to water politics is urban sanitation, which is sector that has in the past been ignored and under-funded by state and intergovernmental donor assistance alike. Since the UN's 2008 "Year of Sanitation", the attention accorded to this aspect of the nexus has risen considerably. According to the WHO, 2.6 billion people worldwide currently lack access to "adequate sanitation" ('unshared facilities that ensure hygienic separation of human excreta from human contact'). The sanitation problem is often associated with rural poverty and practices of "open defecation"[68;69] and set behind the more photogenic and appealing counterpart — the provision of clean water. While water-related research, projects and conferences proliferated, sanitation remained until recently "always an afterthought, if considered at all", with water remaining a greater investment priority[70]. Despite urban sanitation being one of the greatest threats to global health, with over 43% of city dwellers in the developing world living in slums characterised by inadequate urban sanitation, local government and policies aiming to tackle inadequate sanitation are often uncoordinated or underfunded[70;71].

A related dire public health issue in slums is solid waste. Within the waste literature on the global South, there tends to be four main emphases: elaborations of the technical/municipal involvement (tonnage, toxicity levels, heterogeneity of waste materials); the informal waste economy[72] and the environmental (in)justice and politics of waste[35;36;73], and the grave health and environmental consequences of mismanaged and untreated solid waste. Njeru[35] and Nchito and Myers[49] emphasise the importance of recognising the way in which colonial city planning continues to shape the unequal landscape of formalised waste systems. Yet, these colonial legacies continue to be ignored by various solid waste interventions, such as UNEP's Sustainable Cities Programme, which has been implemented in several major cities in sub-Saharan Africa to create 'new forms of functional engagement between states and both the private sector and non-governmental or community-based organisations' to tackle issues such as solid waste management (Reference 49, p. 111).

In these diverse ways, the coping strategies of slum dwellers are disconnected from the majority of formal donor or governmental interventions. The inseparabililty of nexus realities within slums need to be reflected in management strategies, and their urgency of need requires a radical re-think around engagement and intervention strategies and opportunties. These avenues for future engagement and development are explored in Section D, as well as critical reflections on the operationalisability of the nexus in slum spaces.

Section D. Research Implications and Impact

In this section, we extend theorisations and applications of nexus thinking in slums, by offering three conceptualisations that relate specifically to slum ecologies and their relationship to the nexus. Firstly, we advocate for a more explicit integration of waste as the fourth and often unmentioned arm of the nexus. Secondly, we call for a rethink around the role, responsibilities and potentials of the state, ideologically perceived as the primary 'provider' of services and caterer to needs, but practically absent across rapidly growing cityscapes in the global South. Thirdly, we propose "seeing like a slum", to suggest that nexus research could greatly benefit from the reversing of flows of knowledge and expertise so as to theorise the nexus *from* the slum, where inhabitants experience everyday relationships to water, food, energy and waste as integrated. Once the nexus is understood from this vantage point, opportunities emerge for meaningful negotiations and encounters between local communities, local authorities, development agencies and the entrepreneurial sectors.

Waste as the critical but left out 'fourth strand' of the Nexus

As argued by Allouche et al.[74], the water-energy-food (WEF) nexus has often been framed in terms of a "contested trade-off relationship between actors" reinforced by a 'scarcity crisis' narrative. In their article, the authors suggest that the nexus approach may be a mirage of newness that simply offers a different frame to think about familiar resource management challenges as part of broader debates around the realisation of sustainable development. They add that the nexus is fundamentally a "water-centric paradigm", with food and energy security depending on water security (Reference 74, p. 9). At the end of their report, the authors argue that the water-energy-food nexus is reconceptualising what practicing farmers and fishers have known all along, whereby environmental relationships and interconnections appear 'intuitive' at the ground level amongst people whom directly till and come into contact with the land and sea. Therefore, they suggest, the nexus approach can be useful if it is committed to move away from "top-down understandings of the nexus to bottom up ways of knowing the relationship between water, foods and energy" (Reference 74, p. 23). As we explored in Section C, the rural and urban poor operate at localised scales of the nexus given the lack of integrated urban planning, and their immediate need to divest in alternative provisioning strategies. Herein, we align with the argument of Allouche et al.[74] and apply it to urban slums, by drawing attention to the diverse perceptions and experiences of everyday nexus realities in slums where access, the environmental and health impacts, and price volatility of the water-food-energy nexus are entangled with the political economy of informality, resource scarcity and livelihood precarity. Further, it is in focusing on the modes of "knowing" the relationship

between water-food-energy that a critical fourth category must enter the nexus equation, or cycle as it were: waste. It is crucial to consider waste as integral to the cycle of the nexus, both recognised as a potential *hazard* if untreated and toxic, as well as an under-examined *resource* if properly recovered as a critical piece of the resource-energy flows being generated.

First it is worth examining why waste has not, to date, been included into nexus thinking. Dupar and Oates[75] posit that there are risks to nexus thinking insofar as it identifies scarce resources that are "most tangible and monetised, or able to be easily marketed, while potentially overlooking those resources which are less visible (such as biodiversity values) or insufficiently valued (such as carbon)." They ask, therefore, whether nexus thinking under-plays environmental externalities. We argue that yes, and that one such externality is waste.

The treatment of waste in mainstream economics is inextricably tied to notions of value[76]. As Scanlan describes simply in his book *On Garbage*[77], waste can be defined as things or actions that are no longer valued, which in this context relates particularly to use and exchange value. In other words, waste as a residual artefact of household consumption[78;79;80], or of industrial by-production[81] has been regarded (both figuratively and literally) as detritus, rubbish, filth, to be discarded because it is "matter out of place"[82], and because it is no longer of use and therefore *not* a resource. Yet, if we consider the emerging scholarship on "discard studies", which maps the relationship between urbanisation trends and contends that waste may be "thrown away" but indeed never "ceases to exist"[83], it seems clear that waste has not only become an alarming public health and environmental concern in rapidly growing urban areas at every scale, but in order to address both the waste problem AND the challenges associated with water-food-energy security, waste must also be considered a potential resource to be recovered, re-purposed, and treated. Recent calls to action both by policy and business actors alike that implicitly or explicitly evoke the resource of waste refer to the "circular economy", as recently featured in World Economic Forum and Parliamentary publications.[i]

We argue that waste is central to the nexus for how it affects and impacts services'

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[i] While the circular economy tends to refer to an industrial economy focused on principles of restoration (including reliance on renewable energy, reduction or elimination of toxic chemicals and the eradication of waste through careful design), the concept goes beyond the production-consumption paradigm of goods and services, and can be applied to any process that seeks to rebuild different forms of capital, social or natural, and emphasises the circularity of living systems (see www.EllenMacarthurFoundation.org). Importantly in relation to this paper, the circulation economy seeks to challenge the "take-make-waste" linear model.

provisioning as well as the environment. Waste is detrimental to the resource flows of water, insofar as it is a potential source of contamination where there is inadequate separation between waste streams and water sources. This is the case in many areas of North India, where a complete dearth of waste collection strategies in the lower Himalayas results in waste entering water streams, culminating in ever-greater contamination and disease risks as water flows downstream. The need to internalise waste issues is urgent in such places not only due to health and environmental risks, but because development and economic options rely substantially on the tourist industry, which paradoxically can exacerbate the accumulation of waste on the one hand, while also typically associating these spiritual landscapes with pristine aesthetic beauty supposedly set apart from the relics of consumption. Waste is equally detrimental to the resource flows of food insofar as it is again a potential source of contamination if the sites of human or solid waste disposal and those of agricultural production or food preparation are adjacent or overlapping. At the same time, organic waste can be treated and reused as potential fertilizer or renewable energy, just as much of solid waste can indeed be recovered, re-used, re-purposed or re-cycled, and such practices effectively interrupt the proliferation of waste streams. Recent sustainable design and engineering efforts look to convert human waste into useful by-products such as organic fertilizer and renewable energy to address the urban sanitation crisis through "integrated sanitation value chains" (see for example SANERGY's model),[84] which effectively also offers safe toilet options for huge majorities of urban dwellers lacking adequate sanitation options.

The business community has increasingly engaged with the issue of waste along the axes of waste treatment and re-use, particularly for electronic waste, which is a major contributor to urban landfills. Increasingly large Information Communication Technologies (ICT) manufacturers such as Hewlett Packard, Microsoft, Nokia and others are recognising the business as well as "social responsibility" case for engaging with sustainable e-waste management. In slums, the absence of municipal waste management has generated a highly fragmented but lucrative informal waste economy across urban areas in developing countries. Some materials from e-waste such as a mobile phone are disassembled and re-sold to the underground second hand electronics market. Other parts, which have no perceived use/exchange value for informal waste vendors and traders, such as low-grade copper (PVC), are usually dumped or worse, burnt. ICT companies realise that they have an opportunity to prevent this environmental hazard by "buying back" the used e-waste, becoming de-facto customers to informal waste traders and using the "useful" material as recycled parts for new manufacturing production, and safely discarding the unusable parts.

Notably, each of the nexus points are not referring to a natural resource of unrefined/raw state of being, but represent a socio-techno-political hybrid of assemblages and labour and work – outputs of processes. In this sense water is the only nexus point that is a primary natural resource; energy, food (or 'land' or 'agriculture')[85], are all 'made' or constructed. Waste is, in this relationship, the final by-product within the life cycle, but also a critical recoverable resource. Local authorities consistently struggle to keep up with waste, whilst at the local slum level, communities depend on reaping the value of "waste" as a resource but also are the most vulnerable to toxicity given the proximity of low-income neighbourhoods to urban landfills and the lack of municipal services in the residential areas. Once waste is considered a resource, it becomes critical to identify the extent to which local communities can undertake the task of waste management through re-use, re-purposing, and resale, but equally critical to identify the point at which a municipal or commercial intervention could enable safer treatment, disposal, and recovery of waste. Here the role of the state becomes once again crucial to consider, and in what follows we reconsider the state's place in slum provisioning.

The Absentee State

Though the urban literature concerned with slums and its associated urban form is theoretically varied and ideologically diverse, slums are usually equated with informality. The notion of informality and how it should be regulated, governed, and treated has been extensively debated in the last 40 years since Keith Hart's seminal urban labour market study in Accra, Ghana[86]. The implication has been that informal economic activities and by extension informal provision of goods and services were not only described as irregular, casual, and potential precarious, but also outside the remit of state regulation and surveillance. Therefore as urban slums are characterised by informality in all spheres of life, they become to an extent invisible to the state, especially in terms of public provisions. Yet, we argue that the state is an integral part of how things work, or don't work. There may be a lack of municipal support and service provisioning, but the state and other public authorities interface with slum urbanism all the time, to the extent that the "accepted informality"[11] *includes* the state as an *active* agent of informality.

There are parallels to be made with the concept of the "absentee landlord" described by Huchzermeyer[11], which refers to Nairobi's phantom landlords, who occupy a place in the unregulated real-estate market of tenement housing, but whose strategic absence in the neighbourhoods means that they are not confronted by or reminded of their accountability for the health and safety of their tenants. Similarly, the state in the slum is an "absentee state" characterised by strategic interplays of state presence and absence, where many dwellers

(especially those living in semi-permanent tenement-like housing) are taxed on the one hand, but where most experience unpredictable and pervasive black-outs, water shortages, and lack of city council garbage collection on the other. This facilitates a flourishing informal economy and a grassroots "privatization of everything"[87] on the one hand, but this state of being is forever precarious with the threat of bulldozers, eviction notices, and demolitions looming large and real. In sum, the state and its elites are caught up in the entanglements of informal, fragmented, and uncertain nexus provision, and therefore it becomes crucial to recognise the nodes of state-slum relations in everyday nexus practice, and how both elites *and* the subaltern classes strategically manipulate, contest and negotiate this informal sphere[88].

Claims and expectations from slum-dwellers continue to be largely expressed with regards to the state as the primary institution with the moral responsibility and/or potential financial capacity to improve living conditions – or even to formalise them. However, the normative assumptions underpinning the financial capacities and workings of the state do not hold true throughout the nation-states of the world, nor through the multi-layers of individual state polities, as the role and potentialities of the 'state' has marked fragmentations along historical, political, economic, social and cultural lines. The promises and ideals of the Keynesian welfare state pervades expectations of citizens in the developed Global 'North', who have experienced and lived with the fruits of state welfare implementation such as universal healthcare and education, which are currently sorely tried and reduced during austerity. However, the same cannot be stated as realistic expectations of the states of the Global 'South', wherein relatively young nation-states have combined colonial legacies of uneven urban development and provisioning, and often lack the capabilities, whether financial, organisational, expert or technical, to invest and plan for the burgeoning needs and requirements of unprecedented forms of rapid urbanisation. In this way, the states of the Global 'South' are not seeing a 'withdrawal' of the (welfare) state from these same spheres of management, as the 'neoliberalising' trends and theories that pervade the Global 'North' predict, but a persistent ad-hoc and patchwork approach to provisioning, where it is perhaps inappropriate to theorise from a Eurocentric Keynesian model. In the meantime, there is a danger that intergovernmental and civil society actors that attempt to "fill the gap" left by the state create a parallel provisioning system, such that the incentives for the state to provide and represent its citizens are diminished and its "absenteeism" justified. It is this conundrum that demands a reframing of agency and expertise, and we propose that "seeing like a slum" offers a useful lens with which to re-engage and hold accountable the state at particularly local levels of the state-citizen interface.

Seeing like a Slum

In Warren Magnusson's recent book *Politics of Urbanism*, he argues that, "the world is more like a city than it is like a state"[89]. By this he means that the degree of "proximate diversity of urban life" combined with a fragmented, uneven, and "splintered urbanism"[90] makes it impossible to think about, let alone expect, a sovereign state to adequately meet the myriad expectations of rapidly changing, growing and increasingly diverse urban populations. Following this logic, emerging cities, or city-like spaces such as small towns, are not and cannot be regulated or even shaped by a uni-focal state politics and state provision. Rather, cities or neighbourhoods that are in the making and emergent are self-organising, refigured and non-linear. Magnusson adds that "practices of self-government enable civilized order to produce public benefits both in the presence of sovereign authority and in its absence" (Reference 91, p. 7). Of course what is meant by "civilized order" is complex, nuanced and arbitrary – but suffice it to say that some kind of order does take place through a mosaic of incremental efforts and practices of self-government in everyday urban life. This recalls the earlier work of Henri Lefebvre and his notion of "self-government", which in a context of class-conscious citizenship inferred returning power to local communities.

In this context, slum informality is not an imposed condition, but rather an outgrowth of inadequate planning and construction, a result of a direct 'blind eye' or incapacities from the state, to the extent that slum growth itself is a response to "limits of central and local governments to address the issue of urban planning, lack of financial and inadequate human capacity and knowledge"[91]. Crucially, this "urban form" defies modern planning where the nexus of water-food-energy AND waste are integrated into a web of public and private providers. As evoked earlier, the "accepted informality" (Reference 11, pp. 6-7) within slums is reflected in everyday life, where a palpable and embodied experience of the nexus includes residents live alongside piles of uncollected refuse, with sewage spilling from blocked or overburdened pipes, negotiating daily power outages with kerosene lamps and managing the seasonal price changes of water, cooking fuel, and basic food staples. Whilst this informality and the fragmented incremental efforts to cope with unplanned infrastructures can persist, as the expectations of residents shifts and demands vis-a-vis the state or industry attain a critical mass, these infrastructural impediments acquire visibility and gradually attain the status of "opportunity" for improvement schemes of various scales. Examples may include UN-Habitat housing upgrading in horizontal slums, or public-private partnerships focused on improving water connectivity, public toilet construction by local MPs of a constituency running for re-election, or the growing design-for-development initiatives promoting off-grid solar. These initiatives have their own set of politics and unintended effects, but they are expressions of the

continued and growing productive encounters between bottom-up demands and the innovative, increasingly customised solutions from external sources of support.

Conclusions

Within academia and development practice alike, water, food and energy AND waste have to date been studied and addressed as separate aspects of urban provision, treated as technical problems to be fixed one project (or one appropriate technology) at a time, rather than as systematic challenges of urban planning embedded in complex socio-cultural micro-politics and situated lived practice[74, 92, 93]. And yet 'nexus' services in informal and insecure human settlements, and across rural and urban gradients, are inextricably interconnected along many axes of management and experience.

First, for slum-dwellers there is little to no spatial separation of basic services such as water, food, and energy, which are further interlinked through the generation of solid and human wastes. *Second*, conceptualisations of nexus approaches to date have emphasised the needs and benefits of greater efficiency in light of increasingly scarce resources, with water security in particular depicted as central to every other axis[74]. Scarcity debates around natural resources are reflected across research communities concerned with the intricate socio-ecological and metabolic interconnections that exist between human needs and the environment, and these are of course central for the operationalisation of the nexus. But herein, we have argued that concerns with efficiency gains need to be matched with attention to social and distributive justice, in order to consider the vital cultural and political factors that determine equitable resource management and access within the nexus in extreme contexts of dense, makeshift and unplanned settlements. *Third*, we propose a multi-faceted nexus *agency* whereby improved provisioning and opportunities for harnessing interconnectivities is a process of expanded stakeholder engagement, recognising the inherent limitations of the multi-layered state unable to meet the needs of a rapidly growing urban constituency, but equally refusing to "let the state off the hook". Rethinking the role of the state requires us first to understand how and why municipal authorities, especially, have in many post-colonial states been under-resourced and ill-equipped to cover and keep up with urban provisioning.

For these reasons, we have emphasized the importance of paying closer attention to smaller slums and cityscapes in the making, and make the case for future comparative studies across different phases of urbanisation and slum formation. The transient and smaller slums feature a shorter history of uneven urbanisation. As we consider the different legacies of planning and resource allocation at these different slum scales and spaces, the role of the state and what

constitutes "public provision" must be theorised from the South. Furthermore, smaller towns also reveal different forms of civil society organisation, seemingly less prominent or cohesive due to the absence or low-level of proactive donor interest and presence around small town urban development. Therefore, comparative studies across urban scales and sizes are fundamental to contextualising the past, present and potential roles of states, private actors and development agents, whilst consistently retaining a commitment to documenting the vibrant though under-documented forms of iterative, emergent, hybrid, and incremental urbanism taking place in these less visible, 'global' cityscapes. Herein we can recognise the challenges but also opportunities associated with the cultural and socio-economic diversity of slums and slum life, and in this way diverse nexus approaches can build on, extend and incorporate already extant on-the-ground approaches to dealing with the 'nexus' of water-food-waste-energy in such dense settlements.

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