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Addressing the Linkages between Gender and Transport in Low- and Middle-Income Countries

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Abstract: The Millennium Development Goals (MDGs) specifies gender equality and sustainable development as their two central priorities. An area of critical importance for sustainable and gender-fair development is mobility and transport, which has so far been neglected and downplayed in research and policy making both at the national and global levels. Rooted in the history of the topic and the emerging ideas on smart, green and integrated transport, this paper presents a literature review of on gender and transport in the low- and middle-income countries. The paper presents a host of cross-cutting topics with a concentrated focus on spatial and transport planning. The paper further identifies existing research gaps and comments on the new conceptualizations on smart cities and smart mobilities in the Global South. Due attention is paid to intersections and synergies that can be created between different development sectors, emerging transport modes, data and modeling exercises, gender equality and sustainability.

Keywords: gender; transport; accessibility; smart city; smart mobility; low- and middle-income countries

1. Women, Development and Transport

There is a growing recognition, both among the research and the practice communities, that societies across the world are undergoing rapid mutation processes due to convergence of various forms of mobilities. The physical and virtual mobilities are intersecting at an ever-increasing pace in sync with what was originally discussed under the ‘sociology beyond societies’ [1] and the ‘new mobilities paradigm’ [2]. Yet, access to mobilities remains fractured and is unevenly distributed. Here, we would like to clarify the basic position of this paper—transport is distinct from mobilities. Mobilities encompass dimensions like access to opportunities, quality of life and wellbeing of people. The fact that the transport sector is among the top three contributors to GHG emissions, the biggest consumer of non-renewable energy and has most negatively contributed towards climate change, makes it a suitable candidate for further analysis in light of the mobilities agenda, particularly for the low- and middle-income countries (LMICs; the paper uses the terms developing economies, Global South and low- and middle-income countries (LMICs) in an interchangeable manner).

Unabated urbanization and a voluminous growth in personal motorization (driven solely on non-renewable energies) remains one of the key challenges in developing economies. Motorization is expected to continue to increase at an unprecedented rate in the developing parts of the world [3]. Urban areas in these parts are experiencing a dramatic increase in air pollution, roadway congestion, noise, health issues and traffic accidents as a result of increased car ownership. This is occurring in conjunction with substantial shifts from active modes to motorized modes, and a categorical lack of focus on public transport. Thus, issues concerning the environment, climate and renewable energy

gains paramount importance here. Increasing public transport usage and a behavioral shift towards reduced consumption seems to be the only realistic way to curb the negative effects on environment, climate and energy usage. For example, the urban population in India shot from 17% in 1951 to 32% in 2011 and is expected to rise to 35% in 2021 [4]. In absolute numbers, it is estimated that 91 million joined the ranks of urban dwellers in the 2000s. Regarding vehicular growth, 35% of the total vehicles in the country are concentrated in the metropolitan cities alone, which constitute just 11% of the population. Though public transport usage is high, the share of buses is negligible—two-wheelers and cars constitute 90% of the total vehicles on the road in contrast to buses, which constitute less than 1% of the motorized vehicles [4]. In the transport arena, the associated risk, uncertainty and irreversibility (RUI) issues gets exacerbated by the fact that decisions like constructing a highway or major road projects are both resource consuming, practically irreversible and generally operate on longer time horizons [5,6]. The dominance of road building exercises in the Global South, despite the majority of people walking or cycling, highlights that firstly, policies and investment decisions are based on imperfect and incomplete knowledge of the relationship between increased motorization and energy issues, climate change, etc. and secondly, there is a strong lack of a context-based planning methodologies/approach.

Simultaneously, for the first time in the history of policy-making and implementation, both Global North and South are immersed in resolving ways to restructure urban governance in light of Agenda 2030 as many of the areas targeted by the Agenda 2030's 17 objectives are linked to social sustainability and yet ways and means to achieve these objectives remain diffuse. This is particularly the case for gender-based analyses and policy-making. As Razavi [7] notes "In the end, while six of the 17 goals include gender-specific indicators, the indicator framework under five of the goals can be described as 'gender-sparse' (Goals 2, 10, 11, 13 and 17) and for the remaining six critical areas it is depressingly 'gender-blind' (Goals 6, 7, 9, 12, 14 and 15) [8]." The reasons for this apparent gender neglect are many and diverse but one of the simplest explanations is that gender as a category of analysis is difficult to constrain in simple indicator-based systems, more so for systemic issues like climate change urban planning and transport. In the field of urban development and transport, the issue gets further complicated in the Global South, which does not have a strong quantitative data collection and analysis tradition, and thus social sustainable perspectives on thematic issues like accessibility, universal design, gender and diversity mainstreaming, equity, power and influence on planning and decision making, seldom finds its way in discussions and analyses influencing policy making. The primacy of forecasts (based on existing travel patterns) and technical models rule the roost and even when certain trends like 'women exhibiting more sustainable travel behavior than men' [9,10] are established, the prevailing norms of the sector simply do not allow for alternate ways of planning to emerge [11]. Even in societies with a firm agenda on gender equality like Sweden, research suggests that decisions on infrastructure investments and processes followed to reach these decisions are rarely in sync with the broad goals specified in the official documents [12].

This paper builds on the preceding arguments and is positioned in the domain of development planning with particular reference to spatial and transport planning. The paper explores the topic of gender, transport and mobilities in low- and middle-income countries and reflects on critical research gaps emerging from this review. A further layering to the discussion on mobilities/accessibility is provided by the 'smart' city agendas and smart mobilities, which currently pervades discussions undertaken in urban and transport planning domains across the world. The paper structures its arguments with due regards to the digitalization and smart agendas being currently discussed.

Our aim has not been to discuss one particular agenda in detail and given the multiplicity of topics covered in this literature review, we have borrowed from a number of theories. Section 2 highlights some relevant theories while Section 3 presents an overview of the current research findings and gaps identified under a host of topics including access to various opportunities and the issue of safety. Section 3 also highlights the spatial issues of the urban, peri-urban and rural areas of the Global South. The elements of cross-border trading and its importance for women are also discussed in this section.

Section 4 initiates a discussion on the methodologies and data needs for addressing the topic of gender, transport and mobilities, while Section 5 presents the identified research gaps to be addressed in future studies. Section 6 concludes the study.

2. Theoretical and Methodological Underpinnings

In this paper, we reviewed the current status of research knowledge available in the Global South and the research gaps to be addressed in future studies. Our aim was not to discuss one particular agenda in detail and given the multiplicity of topics covered in this literature review, we borrowed from a number of theories.

The complexity of the transport domain calls for a multi-theoretical approach, which considers macro level perspectives as well as the micro determinants for individual attitudes and behavior. Such theoretical foundations are not readily available and need to be constructed through bringing a host of theoretical standpoints to reflect on the theme of gender and transport in the Global South.

We present some relevant perspectives that hold the potential for taking the inclusivity agenda forward. Though the theories, we briefly touch upon here, have been discussed in the domain of travel behavior, they have not been processed to reflect on gendering of travel behavior. This lack gets further pronounced when the current mores of planning smart cities and smart mobilities are put under scrutiny. We propose that these theories merit further deliberation and have the potential to insert a thematic focus on gendered mobilities into discussions related to governance and innovations.

2.1. Social Psychological and Feminist Theories

Taking the element of perceptions forward, social psychological theories related to norms, emotions, attitudes and behavior could be further employed to illuminate peoples' opinions and sensitivity toward socio-technical conditions in the context of everyday travel and likely social and cultural trends. A key issue is also to map various 'cultures' and the gendered variations within different cultures for coping with changing mobility conditions. Relevant theories in this context are the theory of planned behavior [13], norm activation model [14] and theories including habits (e.g., [15]). Dijst et al. [16] provide a good discussion of different attitudinal models for understanding both the gendered nature of travel behavior and the kind of smart interventions, which promises most sustainable solutions.

Taking the agenda of prevalent norms, social and cultural practices, relations and organization of roles of institutions and the subsequent phenomenon of gendering [17,18], the feminist theory insists on studying gender both at the individual level but also at the organizational or institutional levels [11]. Feminist theory can be specifically employed in two particular ways to examine the field of transport [19,20]:

- i. The separation of men and women in transport decision making—Hirdman [20] points out to the mechanisms of separation, which keep men and women restricted to separate domains even when women enter the transport sector. Men are mostly involved in transport both as an economic and policy sector, while women get relegated to the service functions.
- ii. The dominant masculine norms of the transport sector—transport institutions, across the world, have historically been dominated by male bodies and thus the prevalent masculine norms exert normative powers over its agenda [19]. Economic and policy sectors have evolved to operate in the purview of masculine norms and thus its activities coded as masculine, while the service functions tend to be feminine coded.

2.2. Socio-Technical Transition Theory

Socio-technical transition theory [21–25] builds on the premise that environmental problems represent major societal challenges, whose solution requires structural changes in key areas of society. A socio-technical transition is defined as “... a major shift or step change, in which an existing socio-technical system—a cluster of aligned elements including technology, regulations, consumer

practices, cultural meanings, markets, infrastructure, scientific knowledge, supply and maintenance networks—is durably reconfigured” [26] (p. 1003). A key idea is that large-scale transformations are initiated by ongoing activities in small-scale networks (niches), which over time change prevailing practices, competences and knowledge that constitute the existing (transport) system.

The basic ethos of the socio-technical perspective is that transitions are non-linear processes that result from the interplay of multiple developments at three analytical levels: “Niches” (the locus for radical innovations), “socio-technical regimes” (the locus of established practices and associated rules) and an exogenous socio-technical “landscape” [24]. Within the transport system, various “green niches” have emerged like new mobility systems based on mobile ICT technology and electrical vehicles.

In discussing the gender component of mobilities, socio-technical transition theory is relevant since (i) it draws attention to a broad range of elements and actors and their interactions, (ii) analyses of past transitions tells about factors conducive to change and (iii) it shows the social interpretation of technology [26]. This conceptual framework can be applied in understanding both the social trends and driving forces, along with perceptions and access to solutions.

2.3. Mobility Biographies Theory

The biological markers of a woman’s life have traditionally underpinned her freedom to negotiate the inside-outside boundaries. This is particularly true for adolescent girls and young mothers in the GS (Global South) affecting decisions to continue education, employment and seeking health interventions as accessing all the three domains remains interlinked with accessing spaces beyond the confines of home. In light of the importance of life-events, a useful theoretical departure is offered by the life course approaches or ‘mobility biographies’. This strand of research in travel behavior studies underpins that both travel demand and needs change over the life course of individuals. Mobility biographies emerged as a reaction to the aggregate results emerging from analyses of travel surveys where travel demand on an individual level appeared to be relatively stable in the medium term. Once disaggregated by key turning points in life like changes in the places of residence, childbirth, education and employment [27], daily travel behavior underwent marked changes as the spatial distribution of activities and associated activity spaces altered.

The concept is further unpacked by Scheiner [28] as being embedded in other ‘partial biographies’, namely residential biography, employment biography and household biography. Studying ‘mobility biographies’ includes studying the tools, practices and context affecting daily travel behavior, and topics like ownership of mobility tools (such as cars, and access to public transport), factors influencing people to start, stop or significantly change their mobility behavior [29] become important sub-headings to be studied. Most of the studies employing this theory are from the Global North—for example, Chatterjee [30,31] confirm the effect of life course and turning events on the uptake of cycling, Clark [32] expands on the case of car-ownership while Priya Uteng et. al. [33] broach on the topic of car sharing. Thus topics like contextual change, intrinsic motivations, facilitating conditions and the interactions between structural factors and human agency take center stage in discussing travel behavior. The policy implications of studying when and how mobility behavior changes can open up a ‘window of opportunity’ to plan for and maintain (desired) behavioral changes [34].

From a methodological perspective, this approach urges us to go beyond the purview of quantitative studies and engage with the narrative-interpretative inquiries into the meaning and complexity of mobility biographies. This typology of engagement in the transport sector, even in the developed economies with a relatively matured transport research arena, remains scarce [35].

2.4. Social Practice Theory (SPT)

Social practice theory (SPT) attempts to bridge the gap between two primary approaches of treating human behavior—the *homo economicus approach* emphasizing that social order is a combination of individual purposes, intentions and interests and the *homo sociologicus approach*, which relies on the collective norms and values [36] (pp. 245–246).

Rather than treating these two entities of individual vs. collective as mutually exclusive domains, SPT urges us to conceptualize the body, mind, things, knowledge, discourse, structure/process and agent to localize the social within the practice as the main unit of analysis [36]. This essentially means that we focus on both the local or micro phenomena and large social phenomena [37].

SPT defines a practice as a routinized behavior consisting of a set of interconnected elements of *materials, skills and meanings* associated with a practice [36,38]. SPT provides a framework for analyzing the recruitment and retention mechanisms through seeking answers—how practices emerge, how they persist and how they are abandoned—and through analyzing both the product/service providers as well as their users and adopters.

Merging these different theories allowed us to combine results on in-depth analyses of day-to-day behavior with the broader perspectives of policy-making to comment on the fundamental question of “How do practices envisioned in policy-making and those who carry them actually intersect?”.

3. Current Research Findings and Gaps

In the following points, we present some consistent findings emerging from studies focusing on gendered mobilities in the developing countries [9,10,39]:

1. Women’s travels are multi-purpose, complex and resource-constrained (vs. the male norm). Accessibility to health, education and employment opportunities remains constrained for women due to a number of social, physical and economical reasons;
2. Walking, public transport (both formal and informal) and intermediate means of transport (IMTs) are the most used transport modes. Yet, public transport and IMTs inevitably get a lower focus than road/highways/bridge building projects, thus putting women’s needs to a further disadvantage;
3. Safety issues are critical and fear of sexual harassment on public transport and public spaces remain widespread. Fear of sexual harassment and personal security remain great concerns in negotiating daily mobilities;
4. Women on low-income suffer a disproportionately high loss of employment opportunities in the face of slum eviction and relocation. The same holds true for rural women when avenues of employment like cross-border trading does not get enough focus in trade agreements;
5. Cultural restrictions placed on the mobility of girls and women in accessing public spaces influences the time, space and duration of women’s movements. Extreme cultural restrictions necessitate a context-specific and inclusive approach to women’s mobility and transport;
6. The issue of affordability restricts women to a great extent. Constraints on women’s mobility keep them away from income sources and from services, with negative implications for both economic and social objectives of development;
7. Smart mobilities and smart cities do not necessarily help the agenda of creating inclusive cities (findings from the Global North so far indicate smart solutions have exclusively facilitated a particular group—young, educated, high-income, white male).

We looked up the following terms in literature search covering both published works and grey literature (from UN and other development organizations and consultancy reports) to consolidate the findings emerging from across the Global South: Gender and transport ; Women and transport; Gendered mobilities; Women and safety; Urban Women and safety, Transport; Women and cross-border trade; Women, development schemes in low-income countries/LMICs; Access to education, health and employment in LMICs; Urban and rural accessibility, women; Transport and post-disaster rehabilitation; Gender and space; Transport, capacity building; Women, informal transport; Women, informal employment; Transport in developing countries—methodologies; Transport in developing countries—data needs.

In the following sections, we briefly present both the established and emerging issues to frame the problematic of gendered mobilities.

3.1. Access to Education

Linkages between transport, (im)mobility, spatial/social stagnation and resultant poverty in Asia and sub-Saharan Africa have been well established. Instead of being an isolated issue of cultural restraints imposed on girls or a lack of physical access to schools, these two often intersect towards girls' low educational achievement. A study from Morocco highlights that in girls attending primary school tripled to 54% in the area of influence of major paved rural roads, while similar jumps were evidently absent in areas where physical accessibility was still an impediment [40]. Porter [41] presents research findings from a three-country study (Ghana, Malawi and South Africa) where it was consistently found that girls living in remote rural areas with poor roads and poor or expensive transport services were unable to access schools due to an interplay of a variety of cultural, economic and social factors. One of the cross-cutting factors, especially for young girls, is their contribution in the household chores. In the highland village in Malawi, it was found that a significant majority of the students were absent from school on the market days, held twice a week in the nearby towns. Girls were expected to headload local products for sale to the town, which becomes a time-consuming weekly routine since the villages were approximately 8 km from the paved road, with an irregular and erratic supply of public transport. There are myriad examples available from across the developing world, which will confirm the same (refer Box 1). In such circumstances, the inevitable outcome is that girls in remote rural areas often do not obtain even a basic education and further opportunities to develop a livelihood are severely curtailed.

Box 1. Cycling to school: Increasing secondary school enrollment for rural girls.

An innovative program was launched in one of the poorest states of India, Bihar, with an aim to reduce the gender gap in secondary school enrollment by providing girls who continued to secondary school with a bicycle that would improve their physical access to school. Using data from a large representative household survey, Muralidharan and Prakash [42] find that being in a cohort that was exposed to the Cycle program increased girls' age-appropriate enrollment in secondary school by 30% and simultaneously reduced the gender gap in age-appropriate secondary school enrollment by 40%. Distance to the nearest secondary school was a crucial element, and increases in enrollment mostly took place in villages where the nearest secondary school was further away. This suggests that the program was most effective in reducing the time and safety costs of school attendance by providing a bicycle. The Cycle program was deemed as being more cost effective at increasing girls' enrolment than comparable conditional cash transfer programs in South Asia.

Coordinated provision of bicycles or other accessible modes (school bus for a cluster of villages etc.) to girls has the potential to generate externalities beyond the cash value of the program. The cycle program went beyond the mere provisioning of a transport mode, and included positive externalities like improved safety from girls cycling to school in groups, and changes in patriarchal social norms that typically discourages and condemns female mobility outside the village, inhibiting female education and employment at large.

An extensive review of the data across 24 rural, peri-urban and urban sites is now available [43] pointing to major issues around mobility for education, even in urban areas, associated with cost and availability of transport as well as the constraints imposed by demands for children's work within the household.

3.2. Access to Employment Opportunities

Employment in the informal sector dominates the livelihood landscape in the developing countries. Even though the official numbers are typically conservative estimates, they remain staggeringly high—48 percent in northern Africa; 51 percent in Latin America; 65 percent in Asia and 72 percent in sub-Saharan Africa [44]. In the transport domain as well, informal sector dominates both in terms of absolute numbers of vehicles on roads and in the number of people, mostly men, employed in this sector. The informal modes—para-transit and non-motorized transport modes (NMTs)—are primarily the main public transport modes available in a number of developing countries. They form the main carriers of both the vast majority of population and of informal economies. Despite their pivotal role in connecting people to different opportunities, para-transits and NMTs are either unrecognized in

the transport plans or in some instances, rules and regulations insist on either removing them from circulation or barring their access on the main arterial roads.

Non-motorized modes like bicycles and rickshaws and para-transit play a significant role in the lives of women who are dependent on these modes to access employment and other opportunities [39,45]. In urban areas, where often zoning legislation separates commercial from residential areas, women remain the hardest hit if transport accessibility is affected in negative ways. The same is true for women in rural areas as well since they remain dependent on others to sell their products in the regional markets thereby minimizing their control over the profits. Further, availability, affordability and acceptability of transport remains contested. Most formal public transport supply caters to peak hours facilitating the formal sector workers. Additionally, the issue of pricing, and the physical safety of women on public transport also impact their freedom of movement.

The case of Bangladeshi garment workers invokes how a lack of focus on physical accessibility, particularly in the form of safe and reliable public transport, is counterproductive to the issue of making women financially independent and active participants of the society. The ready-made garments (RMG) industry of Bangladesh is a booming industry, which exports to over 30 countries in the world, employing about 1.8 million workers of which 1.5 million were women [46]. On one hand, this case can be celebrated as a major breakthrough of female employment in established sectors and yet a mere scratching of the surface of this success story reveals how both living conditions and capacity to save is severely affected by a categorical lack of affordable transportation facilities for workers on limited wages [47]. For example, planning decisions in Dhaka prohibits cycle rickshaws to drive on certain major roads where several garment factories are located thus putting a ban on the most viable transport mode for the female garment workers. Sharp differences in living conditions and saving potentials were further found among female workers who worked in factories proving bus transport as compared to workers who did not have access to such provisions (for detail discussion, refer to [10]).

Female employment in the Global South is also often within the premises of the household in a format popularly known as home-based manufacturing, which typically ranges from garments, consumable products to providing ancillary product creation for various industries. The savings potential of women employed in the home-based sectors vary greatly depending on physical accessibility to markets as illustrated through the case of home-based garment producers in Ahmedabad, India [48]. She concludes that development decisions need to include a focus on spatial mobility to improve livelihood outcomes of female producers and depending on the sector's market characteristics, an important intervention facilitating women producers could be improving access to the range and quality of markets available to them [48].

Microenterprise credit programs have received innumerable support in the past decades and a Nobel prize simply bolsters the effectiveness of this solution in addressing female empowerment. However, these mechanisms to support women's income generating opportunities and economic empowerment have been contested [49–56] and Omorodion [53] points to the inconclusive nature of the micro-credit programs in improving the economic situation of women. A reading on the topic of daily mobilities highlights that economic empowerment and mobilities remain interlocked. The first issue has already been raised in the previous point and concerns direct access to market. Women's inability to access markets and directly sell their products and make networks to access information greatly inhibits their saving potentials. The ability of this section of women to virtually access information and networks through mobile phones remains contested. Further, lending institutions need to take the accessibility criterion in consideration and locate their outlets for repayments close to markets, training centers and in communities involved in the program, enabling the women to make repayments without social and physical obstructions. The case of Esan women in Nigeria [53] highlight "The lack of financial institutions in rural areas meant traveling long distances to make loan repayments also contributed to the failure of the micro-credit schemes in Esan communities". Nigam [57] reinstates this point through assessing microcredit schemes in five countries—Nepal, Viet Nam, Egypt, India and Kenya. He states that the credit schemes can be truly effective in reducing the worst manifestations of

poverty only when credit dole outs operate in combination with basic social services. Access to market, repayment nodes, basic education and training are among the most vital elements of such services (refer Box 2).

Box 2. Spatial mismatch.

The comparative analysis of working and non-working women's mobility in Navi Mumbai, India [58] reveals that economic empowerment coupled with improvement in literacy levels could result in three to four-fold increase in an average women's mobility. The time and activity pattern study of the working women reflects greater obligatory time requirements, which results in lesser time for travel in comparison to those observed in more developed societies. It was also observed that there are spatial mismatches between the distribution of low paid female jobs and locations where low-income women live resulting in longer commuting by low income women compared to high income women. The working women also are greatly dependent on the safe, reliable and affordable mass transport systems for their long work trips journeys.

Resettlement/subsidized/affordable housing schemes.

One of the most prominent responses of city governments, across the developing world, to the issue of slums and squatter settlements has been resettlement schemes, variants of which can be found under the name of subsidized and affordable housing schemes. These resettlement colonies are typically located in the peripheral edges of the city with poor or no public transport connection. The most immediate response to these resettlement programs has been the loss of livelihood for women, which were originally anchored in walking distance of the slums. The mesh created by distant relocation, inadequate transport services with respect to frequency, connectivity and affordability, unsafe public space designs (primarily bus tops, access pathways) invariably and continuously hits low-income women the hardest. Acknowledgement of these issues, and planning of residential housing areas, which are either mixed land uses or zoned with adequate provision for accessible services and employment opportunities continues to elude development authorities, donor organizations and development sector at large [10,59].

3.3. Access to Health Services and Well-Being

Figures state that between 50%–60% of people in poor countries live more than 8 km from a healthcare facility [60]. Mortality rates for women in time-critical medical emergencies related to childbirth and infant illnesses continue to be high in a large part of the developing world simply due to a lack of availability of access to these health centers [61]. This is typically manifested in form of either lack of transport options, unaffordability or a combination of both (Mlay et. al. [62] illustrates this point through the case of Tanzania and similar case findings from Ethiopia are brought forth by Hamlin [63]). Similarly, to illustrate the prevalence of this incidence in all parts of the developing world, a study from Cebu in the Philippines quantified the (strong) association between infant, child and maternal mortality rates and distance to healthcare services [64] by calculating that a 10% increase in distance from a hospital was associated with a 2% increase in all three mortality rates.

The issue of head-loading continues to plague health deficits of women and is directly linked to their mobility burdens. For example, figures derived from 276 women fuel carriers sampled in Addis Ababa highlighted an average load of 36.2 kg (i.e., 75% of body weight) being carried for an average trip length of 11.7 km, and close to 17% of the women were carrying loads heavier than their body-weight [65]. With reference to the maximum carrying weight of 20 kg recommended by the ILO (International Labor Organization), it is not surprising that these women suffer from eye, chest and back pains coupled with high rates of miscarriage. Porter et al. [66] presents an analysis of load carrying impacts on children from 24 urban and rural research sites in Ghana, Malawi and South Africa, emphasizing substantial detriments to both children's health and their education. A full review of likely health impacts of head loading in sub-Saharan Africa highlights the need to build scientifically validated evidence base with health professionals.

The incidence of HIV has also been linked to transport availability and spatial concentration of medical services. Several cases from Africa highlight that comprehensive HIV services, primarily provided through hospitals, remain inaccessible to rural population. The cost of transport to these facilities is often high, and Amnesty International calls for a meaningful consideration to the transport

needs of economically and socially marginalized people, especially rural women at risk of or living with HIV.

One of the research gaps identified so far is that there is little recorded evidence in the form of research studies to highlight the constrained access of urban low-income women to health services. Most of the studies in urban areas have focused on the quality, patient–provider relationships, accountability and affordability of the health services [67]. However, referral services like assisted or non-assisted transport services have been rarely studied in the urban areas of the developing economies, except for studies such as that by Murray et al. [68] that focused on Lusaka, Zambia and there is need for much more rigorous research work.

Essentially, even in the urban areas, women and girls experience maternal death and a myriad of health-related problems for reasons similar to what has been consistently found in the rural areas—lack of affordable and reliable transportation to clinics and hospitals. A combination of lack of ambulance services to the urban slums and unaffordable public transport often leave women in extremely dangerous conditions [69,70]. During a focus group conducted with female residents of Bwaise slum in Kampala, Uganda, it was revealed that women were restricted by financial resources and distance. “It took at least one hour to walk from Bwaise to the nearest health centre, and there are reports of women giving birth en route. The only vehicular access to health centres is by boda-boda (motorcycle taxis) because of the poor conditions on the surrounding roads” [71]. One of the concrete suggestions put forth by the female slum residents was provision of an ambulance station (or a designated pickup point) in close vicinity of the slum.

3.4. Humanitarian Efforts, Post-Disaster and Post-Conflict Rehabilitation

Massive humanitarian efforts and resources are put in the post-disaster/post-conflict rehabilitation processes. These processes of transitioning from relief to development offer unique opportunities to correct spatial development-related imbalances and reduce vulnerabilities to hazards [72]. However, decisions under these stressful circumstances are taken more as a response to establish immediate control rather than pre-mediated rehabilitation decisions with long-term consequences [73]. For example, the primary focus of post disaster investments in Honduras after Hurricane Mitch was on major arterial or secondary roads and not rural roads. Often, implementation of the transport sector’s modern rhetoric of sustainability, gender and the environment are strangely absent. Post disaster reconstruction stages need to be streamlined to reconstruct with change thereby avoiding the creation of new vulnerabilities or exacerbating the existing ones. The International Forum for Rural Transport and Development [74] notes that ‘prioritizing the rehabilitation of rural road networks to enable small farmers to access markets could potentially discourage post-disaster migration to vulnerable rural areas and urban slums. By continuing to listen to the needs of the poor in the post-disaster context, the transport sector has the potential to avoid creating new societies with even greater vulnerability.’. In light of the unprecedented urbanization taking place in the developing economies and issues like, which we expand on in the later sections of the paper, feminization of slums in the urban areas, cross-border trading in which women are heavily involved, inserting evaluation and implementation of accessibility modules in the rehabilitation processes becomes a necessity.

3.5. Traffic Injuries and Women

The World Health Organization [75] reports that 90% of the world’s road fatalities occur in low- and middle-income countries, even though these countries have approximately only half of the world’s vehicles. Majority share of fatal injuries consist of ‘vulnerable road users’ comprising pedestrians, cyclists and motorcyclists. It is also reported that globally, three out of four road deaths are among men [76,77]. However, when we start analyzing disaggregated data in the low- and middle-income countries, a different picture emerges but is often under discussed as both access to and analyses of disaggregated data remains problematic in the low- and middle-income countries.

For example, Ghanaian accident data highlights that over 40% of fatal road traffic accidents (RTA) involved pedestrians, and the majority of these were women [78].

As previous sections have highlighted, women constitute a major share of pedestrians in the LMICs owing to their livelihood options like street vending, hawking and unaffordability to use other modes of option than walking. Street vending across the LMICs operates through the modality of sharing road space with the motorized and non-motorized vehicles thus putting women in precarious situations. Further, Williams et al. [79] highlight the age dimension specific to the case of LMICs where the incidence of falls among elderly women remains much higher than men.

The intersectionality of traffic injuries remains an understudied topic, particularly in the LMICs. Reasons and the particular ways in which women are or become victims of road accidents needs further probing [80].

3.6. Safety, Smart Cities and Smart Mobilities

It is not new knowledge that women across the world are more fearful of crime than men. This fear gets accentuated by a combination of limitations to defend themselves in face of physical attack and a greater propensity to transfer past experiences and memories of victimization to present [81]. For example, in Chennai, India, 66 percent of female respondents stated that they have been harassed while commuting [82]. A series of studies document the prevalence of fears and concerns about safety in the developing world. They plot how such fears influence travel decisions taken by women and can have a substantial impact on both the volume and timing of ridership. In tandem with the main findings from a U.S. based study [83], studies from the developing economies come to similar conclusions—there is a significant mismatch between the safety and security needs and desires of female passengers and the types and locations of strategies public transport agencies use [59,84–89]. Studies focusing exclusively on safety concerns of women on their daily travels are scarce in the developing world. However, the ones that have studied this topic unanimously assert that safety concerns have strong contextual determinants—public lighting, characteristics of sidewalks, isolation and neighborhood characteristics [90]. Perceptions of insecurity in a variety of urban environments—at the bus and rail stations, on their way to and from the bus and rail stations, etc.—are a primal force restricting women from achieving their maximum potential not only in education, employment and health, but in their general well-being.

A major criticism of the smart cities approach is the gap between the technical/digital approach and quality-of-life approaches. Lauwers and Papa [91] claim the shift from conventional mobility planning towards smart mobility is primarily applying new technology to existing infrastructures instead of creating better solutions. For example, buses are being retrofitted with tracking devices rather than increasing public transport supply and checking outcome measures such as access to work, education, etc. In this sense, smart mobility concerns itself primarily with innovative technological or consumer-centric solutions rather than adopting a social sustainability lens to the entire mobility agenda.

Studies exploring the under-delivery of smart solutions for women are restricted to the Global North, but they have conclusively established the fact that smart solutions can be highly exclusive. Shaheen et al. [92] studied 23 bike-sharing programs in North America and found that the main obstacles identified for low-income groups were the need for smart devices, debit/credit cards, minimum bank balance or deposit to cover for vandalism or theft. Although there has been a considerable increase in smartphone users in most developing countries, and this continues to grow, the actual penetration level by population remains less than 50%. Further, there are examples of significant disparities in access to smart phones between men and women in some Asian and African countries. For example, women in India between the ages of 15–65 are 46% less likely than men to own a mobile phone, while in Bangladesh and Rwanda women of the same age group are 62% less likely than men to use the Internet (for details, refer to Box 3).

Box 3. AfterAccess: Uncovering the gender gap.

AfterAccess is a large-scale data collection initiative aimed at compiling comparable information and communication technology indicators for countries in the Global South. The survey has focused on creating comprehensive mobile and Internet use database for the Global South. Funded by IDRC and conducted jointly by DIRSI, LIRNEasia, and Research ICT Africa, AfterAccess surveys collect data on ICT access and use through household and individual surveys across 22 countries, covering a sample of 38,000 and counting. The sampling method allows for representation with a plus or minus 3% margin of error, and the sample sizes are large enough to allow for gender-disaggregation of the indicators collected. Among other factors, the surveys measure the gender gaps in mobile and Internet usage. The disparities reveal a sobering picture in some Asian and African countries. For example, women in India between the ages of 15–65 are 46% less likely than men to own a mobile phone, while in Bangladesh and Rwanda women of the same age group are 62% less likely than men to use the Internet.

Such analyses assist us in reflecting on the relevance of Smart Cities approach in current times. Before implementing smart solutions, which are primarily based on digital interface, we need to address the gender gap of women's (versus men's) access to and use of ICTs and gendered barriers of use to enable evidence-based policymaking.

Source: AfterAccess: Uncovering the gender gap (<https://www.idrc.ca/en/research-in-action/afteraccess-uncovering-gender-gap>)

Another issue concerns the lack of digital literacy, knowledge, comfort and confidence to use smartphones. In many emerging economies, disparities in digital literacy compound disparities in basic literacy and reduce people's access to smart solutions and services.

Ride-sourcing (also known as 'on-demand-rides' or 'ride-hailing') is one of the most popular forms of smart mobility. However, there have been some considerable safety setbacks because cases of drivers sexually assaulting female passengers have emerged from across the globe. Given the emerging demand for safe transport services for women, women-only ride-hailing services (exclusively women drivers and passengers) have been launched in many countries, such as Riding Pink in Malaysia, LadyDriver and FemiTaxi in Brazil, See-Jane-Go in the USA and almost a dozen similar services in India. In Indonesia, where people often hitch rides, two women-only, motorcycle ride-hailing services, LadyJek and Sister Jek, were launched. Ways to factor in safety in the smart solutions need immediate and urgent attention [89,93].

On the positive side, apps like *Safetipin* facilitate mapping exercises that can greatly enhance weeding out unsafe spaces, corridors and routes (refer Figure 1). In 2014, *Safetipin* was launched in India to help women safely navigate the city by identifying its safe and unsafe zones [94]. It is a location-based mobile app that collects safety-related information and conduct safety audits of different places by calculating a safety score. Users of the app can identify how safe certain areas are and can plan their travel routes and timings accordingly. The safety audit is based on nine parameters—*lighting, openness, visibility, security, crowd, public transport (connectivity), presence of women and children, feelings of safety and presence of footpaths or walkways*. Safety scores for Nairobi are illustrated in Figure 1 (for further discussion, check [93]).

Each of the parameters, except for feelings (of safety), is measured objectively using a rubric and scored on a scale of 1 to 4 (from 'poor' to 'good' conditions). The safety data is available in multiple forms, including maps, reports and csv files, which can support urban stakeholders in making judicious urban planning and monitoring decisions, such as identifying areas that need more lighting, security, CCTVs and/or public transport at night. *Safetipin* has now extended to more than 20 cities, including some outside India, such as Bogota, Manila-Quezon, Jakarta and Nairobi.

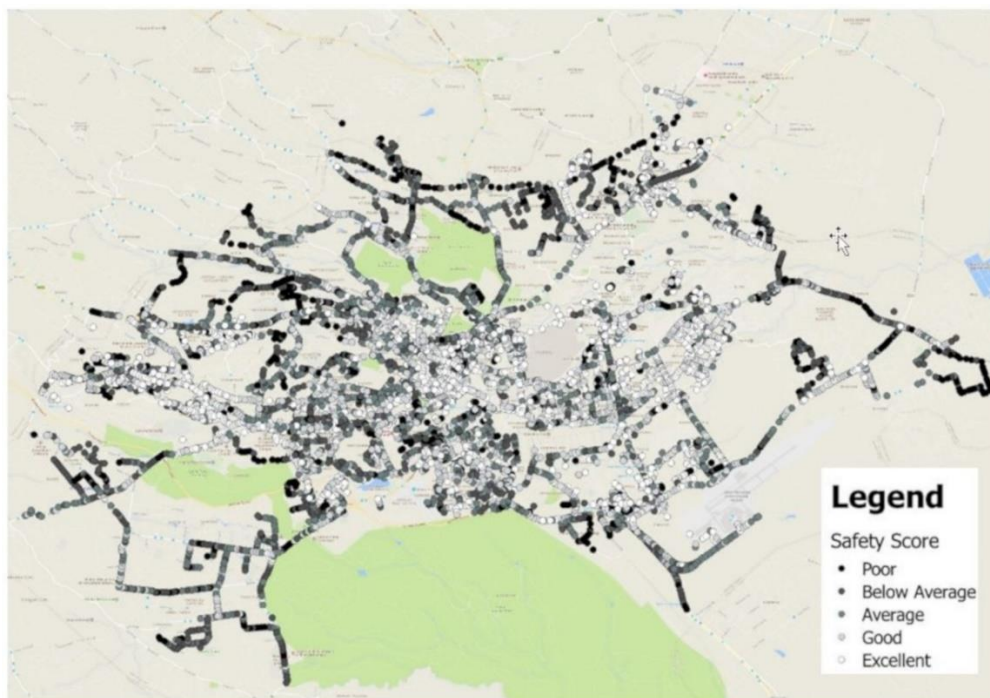


Figure 1. Safety score for Nairobi (source: Safetipin [95]).

Such exercises have become relatively easy, cheap and accessible to planning authorities across the world. We urge a replication and continuous mapping of safety as part of the smart cities/mobilities agenda (for further discussion, check [93,96]).

The safety scores that Safetipin has generated in the case cities have driven city leaders to take action to improve women's safety. In Bogotá, Safetipin has assisted policymakers in helping to create a data-driven approach to women's safety in public space. City officials have been able to combine data based on the safety audits with other data sources in order to better understand urban problems. For instance, the city was able to overlay maps indicating Safetipin's security parameter rating with maps of police station locations and incidences of crime. Based on Safetipin data, the city identified five priority locations for interventions to generate a broader dialogue about women's safety at night that included local operative councils for women and gender, local women's organizations and citizens. These public engagement activities are key to educating people and changing people's perceptions and attitudes about women, gender and gender-based violence.

Data-driven approaches to women's safety are increasingly being adopted in other cities as well (for example, web-based interactive map campaign 'Free to Be' [97]).

3.7. Feminization of Slums

This section builds on the increasing feminization of slums and spatial development rationales. It establishes links between transport and housing policies and the need for these two sectors to work together to facilitate women's mobility.

Across a sample of 51 developing countries from Southern Asia, Latin America and sub-Saharan Africa, women are more likely to live in slums than men [98]. For a majority of the countries, there are 108 women living in slums for every 100 men in the same category. Living in slum conditions means that residents lack access to access to safe water, adequate sanitation, durable housing, sufficient living space and/or security of tenure.

For Kenya, housing the world's fifth largest slum by population size, there are 13 more women for every 100 men living in slum conditions. The figure is 15 or more women aged 15–49 for every 100 men of the same age group in other countries, including Swaziland, Gabon, Ghana, Cameroon and

Senegal. In Colombia about 11 and in Dominican Republic, Bolivia and India, about five more women aged 15–49 respectively live in slum conditions than their male counterparts.

There is a further spatial layering of center vs. periphery. Lima et al. [99] underline that land use in Recife's Metropolitan Area does not obey the center-periphery occupation pattern (European) or the periphery-center occupation pattern (US). This observation, however, is applicable to a host of developing countries. A common denominator to urban development in the developing countries is the fact that slums and poor communities are scattered throughout the municipalities, in conurbation with the richest neighborhoods. There are trends in some developing countries towards in-situ establishment and legalization of the slums. For example, in the case of Recife [100], through establishing special zones of social interests (known as ZEIS) in 1980s, legal right to the urban land of previously informal low-income settlements was recognized. This paved way for a spate of formal services being provided to the area to improve urbanization standards, provide basic infrastructure (e.g., sewage, drainage, pavement and water supply) and legal tenure of these settlements [100]. Contrary to this case, there are myriad cases of slum relocation and allotment of low-income housing in the peripheries of urban areas with little or no public transport available to these areas. Women remain the hardest hit group in these reallocation schemes with loss of employment and further isolation from income-generating avenues. Majority of slum dwellers in Kolkata predominantly walk (56%) for their travel needs followed by bus travel (26%) [101]. In terms of travel distance, nearly 50% of slum dwellers commute within 0.8 km, while 75% travel within 1 km. The percentage share of income on transport expenditure tends to increase for slum dwellers residing away from city centre, which exhibits that slum dwellers tend to limit their travel distance in order to optimize their travel expenditure. It was observed that with improved accessibility, per capita income of slum dwellers tends to increase due to better access to work opportunities. The per capita average monthly savings of slum dwellers is more sensitive with transport accessibility than accessibility to employment opportunity highlighting the importance of transport in improving standards of living of urban poor. In light of 'feminization of slums' (refer Figure 2), which is a rapidly increasing phenomenon, there is a need to understand the gender differences in this experience and report gender disaggregated travel patterns [102] (refer Box 4).

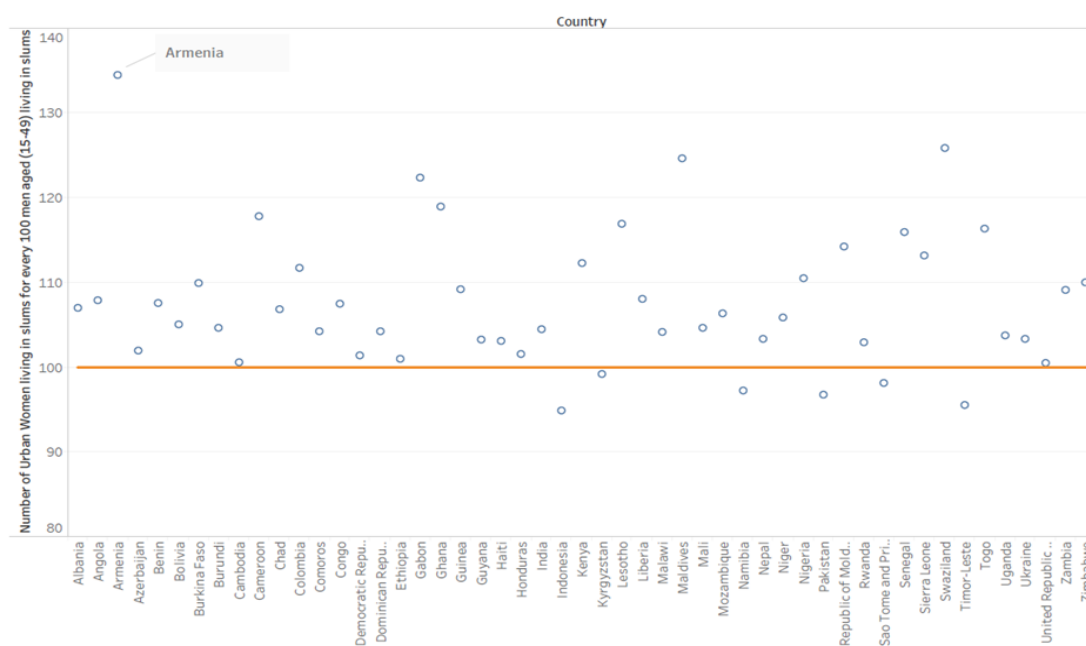


Figure 2. Urban females aged 15–49 living in slums for every 100 males aged 15–49 living in slums, 2007 or later (Source: UN Women calculations based on USAID 2018 [98]).

Box 4. Mobility, poverty and gender: Travel ‘choices’ of slum residents in Nairobi, Kenya.

Salon and Gulyani [103] present the gendered variations and the empowering potential of daily travels of female slum residents. Their findings are based on one of the most comprehensive travel data collected for slum population in the developing countries—survey of 4375 slum residents in Nairobi, Kenya. Analyses revealed that though majority of the slum population could not afford any of the motorized transport options in the city and coped by limiting their travel outside their settlement by often ‘choosing’ to walk, the burden of reduced mobility is borne disproportionately by women. Women faced distinct barriers to access, and though policies aiming to improve mobility and transport access for the slum population first and foremost need to address the issue affordability, but specific constraints faced by women needs additional support.

The story that emerges from our analysis is that both poverty and gender matter in explaining differences in the travel choices of working adults in Nairobi’s slums. It is expected that poverty level would affect travel choices, but the gender effect that we find is surprisingly strong among adults. Characteristics of women’s travel are systematically distinct from those of men in this population, even when controlling for poverty level.

Policy implications—four divergent policy implications emerge from their study, and other studies confirm that these are widely applicable in the developing contexts across the world:

- i. Affordable and reliable public transport—if affordability increases—either through reduction in poverty or lower fares—women’s use of public transport will rise sharply.
- ii. Child care facility—for women, children in the household greatly reduces their chances of being employed, while men become more mobile. Gainful employment takes place either by working closer to home or through running a household microenterprise (HME). Provision of (affordable) childcare facility can enhance employment opportunities for women.
- iii. Education and employment—women reap larger mobility gains from education than do men. The increase in the likelihood of using matatu (local informal public transport) is accompanied by a large decrease in the likelihood of being unemployed.

For rural areas, the location of market and health centers, and access to vocational training and higher education gains paramount importance in ascertaining how much of the benefits finally percolate down to women. Specific and targeted interventions like providing cycles to girls in high school (Cycle program in the state of Bihar, India) greatly reduce the ‘distance cost’ of attending schools and related opportunities. “Comparisons with conditional cash transfer programs in other South Asian contexts suggest that the Cycle program was much more cost effective at increasing girls’ secondary school enrollment than an equivalent-valued cash transfer. Given the importance of increasing women’s education attainment in developing countries like India (especially in its most under-developed regions) and the fiscally-constrained policy environment, these results are important and suggest that the Cycle program was not just politically popular but also much more cost-effective than the most frequently considered and implemented policy alternative to increase girls’ secondary school enrollment in developing countries in the past couple of decades (CCT’s).” [42] p. 26).

3.8. Space, Access and the Informal Economy

“Engagement with informality is in many ways quite difficult for planners. Informal spaces seem to be the exception to planning, lying outside its realm of control” [104] (p. 155). What Roy further argues and builds in the same paper is that though informality is the exception, it is an outcome and product of the state. What is important to note that in the developing countries, informality encompasses all modes of production and access to these modes of production.

At the same time, informality continues to facilitate women. Women are either equal participants or, in some cases, dominate the informal markets, trades and usage of the informal transport modes. In urban areas, these three facets get typically expressed by:

- i. Creation and adherence to land use plans without giving recognition or space to the informal use of land, thus treating land use, social development, women empowerment and distributive justice as separate blocks;
- ii. Prioritizing car-based mobility or an imposed public transport system, which fails to both recognize the already existing informal modes and to cater to the majority of the population;

- iii. Borrowing and implementing best practice models, which might not be conversant and fit for the local context.

Another area of neglect is cross-border trading, both formal and informal, which severely affects the lives of rural women. Informal cross-border trade (ICBT), a trade arrangement, which is informal, and thus precarious, remains dominated by women traders in the rural areas. Though this fact is more pronounced in Africa, increasing evidences can be traced in Asia as well. Kusababe [105] (p. 582) puts it “Very little literature exists on the gendered effect of international borders. Of the few extant studies, scholars have elaborated how geographical borders define and label women’s work. Cheater [106] shows how cross-border ‘shoppers’ in Zimbabwe were labelled as a security threat to the country. Vila [107], in her work on the US-Mexico border, demonstrates how borderlands, as margins of society, are seen as ‘dangerous’ and full of ‘vice’, and that certain gendered behaviours and attitudes are seen as characteristic of Fronterisas/os. Similar findings are reported by Biemann [108], who concludes that, ‘The border thus becomes a metaphor as well as an actual material institution that capitalizes on the differences between the economic and the sexual’ (p. 108)”.

ICBT or in the absence of formal regulations around small-scale trade what is often deemed to be ‘smuggling’ has had positive effects for women, which is highlighted in the scattered research studies and reports found on this topic. However, to date, this form of trade is not typically recorded in government statistics leading to an obfuscation of data and consequently the roles and needs of women traders. The gendered effects are significant given that 70%–80% of African traders involved in ICBT are women [109–112].

Kusakabe [105] (p. 581) highlights how “the formalization of the border trade has changed women’s ‘sense of space’ and their relations with men and other women”. Her study highlights how international borders create different scales of places [113], and women’s ability to access these scales depends on both material (transport connectivity) and social (societal and household’s definition of gendered work) definitions of access. This is significant in the context of increasing efforts to improve the ‘efficiency’ of regional land borders through the introduction of technologies and harmonization of bureaucrat processes.

UN Women [114] notes that poor infrastructure in terms of poor roads, energy and communication is known to be one of the non-tariff barriers to trade, preventing women to access international markets. Across value chains infrastructure, access to market is a critical element, especially for transportation of perishable agricultural products, which are mostly traded by women informal cross-border traders.

A few of the research areas that should be further investigated while designing regional transport corridor development schemes are as follows:

- What are the inter-linkages between transport provision (both hard infrastructure and gendered access to the transport resources), value chains and gender inequality?
- What are the main mobility challenges and opportunities for women entrepreneurs in the context of cross-border trade?
- What are the potential ways of improving regional mobilities?
- What are the potential ways of integrating gendered mobilities concerns into value chain of development projects and programs to assist women in maximizing their profitability and competitiveness?

It is to be borne in mind that limited sex-disaggregated data on gender and cross-border trading was found in this review and this inhibits sound empirical evidences. Studies should further delve into existing knowledge gaps on the opportunities for businesses owned by women in the context of procurement schemes, training facilities and access to markets.

Though the relationship between space and informality is beginning to emerge and accepted at the urban levels, this relationship is largely hidden in discussions on cross-border trade. Sadly, in tune with the neatly compartmentalized discussions in different sectors, though informal work or trading has been examined closely, the relationship between space, informality and access lacks similar

engagement. Studies documenting the incidence of cross-border trading highlight that international borders often create a space where income earning activities are being practiced, assigning both status and new roles to women [115–117] but due to the lack of public transportation and high transportation costs, women, in particular, faced hardships in directly accessing the market and claiming the revenues. Kusakabe [105] highlights this case through two examples drawn from Lao PDR—(i) cotton-weaving activities in Sayaboury province, and (ii) sticky rice box production in Kammoune province.

3.9. Development Planning and Transport

Lack of gender balance in decision-making, ranging from the macro level in parliaments to community and household levels have been routinely noted. Consequently, women’s perspectives and priorities are not reflected in budget allocations and development related decisions. Seminal works like *Male Bias in the Development Process* [118] highlight that male bias is easy to understand, empirically testable and in principle can be rectified [119].

Given that a large share of low-income women is employed in the informal market, governance issues built on employment and related schemes need to strengthen their focus on accessibility. The fact that a large share of daily travel needs in the developing economies are met by informal public transport modes like tuk-tuk and jitneys, such bottom-up initiatives need to be both recognized and bolstered in the government action plans for transport, urban/rural planning and development at large. Even most basic infrastructure like mapping of these informal intra-city routes are largely amiss (most transport plans lean towards the case plotted in Box 5).

Women are typically less likely to find employment in the transport sector at large, but this is especially pronounced for the developing economies. This inadvertently results in rendering women’s needs invisible, even in the provision of informal transport, which is largely market responsive and highly adaptable.

Box 5. National urban transport policy (NUTP) of India.

Realizing the importance of public transport and cycling and walking in the cities and equity concerns, the national urban transport policy (NUTP) spelt out the following objectives: (i) To bring about a more equitable allocation of road space to various users through building a people-centric rather than vehicle-centric focus. (ii) To encourage greater use of public transport and non-motorized transport (NMT) modes by offering central financial assistance for this purpose and (iii) to enable the establishment of multi-modal public transport systems that are well-integrated, providing seamless travel across modes [120]. Under the Jawaharlal Nehru National Urban Renewal Mission’s (JNNURM) Urban Infrastructure and Governance (UIG) component, 24.2 per cent of the total allocations were for transport related projects. However, 13.3 percent of the transport related project was road widening and flyover building and only 8.66 percent was for mass transit development and the rest for parking and other small transport projects [121]. Despite a positive shift in policy objectives and priorities, the largest portion of the transport related funds in JNNURM were spent on road-building instead of allocating them to public transport projects.

The case of Dantewada, India, establishes how women can themselves tackle the deep-rooted inadequacies of the transport system, culminating from the inaction of both ‘state’ and ‘private’ actors. In the lack of any form of public transport connectivity, the tribal women of this remote rural area organized themselves through self-help groups. Through government-sponsored subsidy schemes, they have been successfully running E-rickshaws connecting rural markets, schools, etc (Figure 3).

The Kenyan case is also worth mentioning here (Figure 4). Though the Kenyan transport sector remains largely male dominated, women are increasingly participating in the (informal) transport sector as owners, drivers, touts, stage clerks and fleet managers [122]. The female workers employed in the informal transport sector in Kenya comment that they have no contact with the formal social protection schemes as they are categorized as being ‘informal’. There are two sets of facts to be considered here for Global South at large. Firstly, there is a predominance of informal transport systems in the developing countries, which might provide employment opportunities to females. Secondly,

given the eventuality that women do find a space in the transport sector, as in the case of Kenya, Kamau [122] raises the following questions:

1. Can we design and integrate social protection for women transport workers?
2. How can this be guaranteed?
3. Are their services being valued? What is the evidence?



Figure 3. Taking the daily mobility needs head-on. E-rickshaws and tribal women of Dantewada, India (source: Chhattisgarh:E-rickshaws drive a change in the lives of Dantewada’s tribal women. (<http://www.newindianexpress.com/thesundaystandard/2018/feb/03/chhattisgarh-e-rickshaws-drive-a-change-in-the-lives-of-dantewadas-tribal-women-1767909.html>)).



Figure 4. Female (informal) transport workers in Kenya (source: [122]).

4. Methodologies and Data Needs

Though the presented findings are consistent for developing countries across the globe, they cannot be periodically corroborated as most developing countries do not conduct periodic travel

surveys or qualitative evaluation of the situation. This means that the gendered patterns of different and differentiated mobilities do not get highlighted and consequently are not acknowledged in the planning and design processes. The increasing penetration of mobile phones, even in the remote and poverty-stricken areas, in developing countries has to some extent changed the landscape of how women negotiate their daily mobilities. Developing routines and systems for data collection on revealed, preferred and digital mobilities, thus, holds the potential of assisting policy-making. The analyses emerging from these surveys can help the research and policy-making field to comment on:

- i. Given the current system, roles, jobs and gendered divisions—what are the current mobility needs of women (both urban and rural)?
- ii. Assuming a world, where women have an increasing degree of freedom, what kind of arenas will be available to them? For example, more female related growth of economy. We can look at the case of advanced (and equitable) economies like Norway for the division of labor in different sectors. What are future mobility needs?
- iii. What kind of transportation policies and investment will ensure an increased accessibility to women?
- iv. Are there systemic and systematic flaws responsible for gender-bias transport policies?
- v. How do land use regulations or the lack of it affect the mobilities in urban and peri-urban areas?
- vi. Which kinds of mobilities (both urban and rural) are being supplemented/complimented or substituted by mobile phones?
- vii. How can women's priorities and needs be included in planning and monitoring transport systems?
- viii. How can transport be made affordable for women, particularly the poorest women?

Rather than advocating simple data collection, it is imperative that data collected in surveys is segregated at the level of gender, activities (land use) and time-use, which can essentially inform the transport planning authorities to take a more needs-oriented approach. Mobility-gap analyses should form an inevitable part of routinized data collection (travel behavior surveys) and analyses. An explanation of the gap figures, for example in terms of average daily trips and time used by different types of households, sheds light on the distribution of mobility opportunities among the respective genders.

Further, given the high incidence of no travel to work [123] and limited trips on a daily basis (a recent one-day trip diary from the city of Bengaluru, India revealed that only 20% of female respondents had taken a trip on the interview day (source: Personal correspondence, Tanu Priya Uteng), it is crucial that the popular methodology of the Global North focusing on a one-day travel diary is not adopted in the developing economies. Instead, at least a one-week trip diary approach should be adopted to filter out the trips that women are making over an expanded period of time (Box 6 illustrates a case from Indonesia).

Box 6. Time use allocation, transport poverty and social exclusion.

Through exploring the time use allocation and immobile behavior using a three-week time use diary collected in Bandung metropolitan area (BMA), Indonesia (one of the first multi-day time use studies within developing countries context), Susilo and Liu [124] establish clear differences of weekday and weekend patterns of time use allocations and mobility behaviors across different socio-demographic groups and gender. There exists a strong tendency of social exclusion due to transport poverty. As a typical patriarchal society in developing country, women are still responsible for housework and thus have a shorter contract time, free time and travel time but longer committed time than men on both weekday and weekend. Housewives also have a particularly low travel time, indicating that either due to unaffordable public transport services or lack of time, they may not travel a far distance.

Integrating data collection across sectors also holds the potential for addressing the needs of women in a more robust and target-oriented fashion. For example, maternal mortality indicators have received a lot of attention and are a good indicator for demonstrating the efficiency of an entire health system. However, unpacking this indicator, availability of transport, availability of medical supplies, presence of trained health staff and access to health facility are major factors affecting maternal mortality rates. Thus, programs aiming at decreasing maternal mortality should have a detail analysis of mobility component as well. In areas where this access is problematic, complementary programs to address this issue specifically should be introduced, either through training the nurses to ride bicycles/motorbikes, providing support for owning a community cart, etc. The broad aim of building capacity of the public health authorities to promote equitable access to primary health care services needs to be broken down into workable components, based strictly on the contextual realities. Given such benchmarking, it will become easy to assess the specific kinds of alterations needed in the mobility systems to adapt towards gendered needs (for example, usage of mobile phones to substitute the missed trips and access information). This applies at both rural and urban levels. Community health workers in rural Bangladesh and Indian's ASHA workers are both response to inaccessible hospitals in the rural parts of developing world.

Further, there exists a need to link the 'soft' or qualitative information to the 'hard' data information. This can aid in developing a model that corresponds much more to 'everyday transport functioning' than the much-used classical, techno-economical approach to transport model designing.

Projects can employ both traditional methods like focus groups/questionnaire surveys/measuring actual behavioral response to different measures (for example, concessionary bus cards, channelizing feeder services, a change in the bus frequency, assistance in getting mobile phones as part of the development schemes like self-help groups, etc.), and new methods like mobile app-based data collection, to understand the existing travel behavior and adaptive preferences of different groups. Studies conducted on these lines (e.g., [125–127]) have found that discretionary trips have a greater number of adaptation alternatives available from which to choose than non-discretionary work trips. This is applicable to the case of gendered mobilities in developing countries where a major share of women's trips caters to discretionary purposes of combining various household/social/shopping related purposes.

Analyses of travel behavior, constraints and accessibility need to be triangulated and complement quantitative and qualitative data collection techniques.

4.1. Roadmap to Applied Research

4.1.1. Travel Survey

Travel survey data contains relevant information on all personal daily mobility, including information on multimodal trips, transport modes, distances and times. Such datasets additionally contain an extensive list of respondent and trip background variables, including socio-demographics, occupational status, home and work locations (possibly multiple), weekly working hours, occupational status, education, income, etc. Such datasets are generally not collected in the developing countries or collected as an adhoc exercise rather than being part of a regular data collection regime. We suggest using both the traditional and wherever applicable, the mobile interface to collect this dataset in the developing countries. Given the high penetration of mobile phones in the developing countries, an app-based method can be a viable option for data collection in the urban areas.

A one-day trip diary will invariably fail to capture the nuances of women's movement as there is a strong prevalence of a no-trip phenomenon on single days. Thus, the least time period assigned for trip data collection should be a one-week period to capture the clustered travel phenomenon.

Existing studies demonstrate that the use of location-based technologies reduces missing data on travel days and trips and improves the accuracy of departure/arrival locations and times over traditional travel survey data [128]. Modules are already available to extract the entire travel diary by

accessing the smartphone data provided by the telephone operators. This data can be further enriched with local and regional spatial data from external sources, such as Open Street Maps, census, register and cadastral data.

4.1.2. Attitudinal and Preference Survey

Attitudinal and preference travel survey distributed over different types of residential environments (inner-city, outer-urban, suburban, peri-urban and rural) and population categories within these regions will assist in capturing habits, attitudes, subjective well-being, perceived barriers and motivations with regard to the access to health, education, and employment opportunities [129]. Background information on personal and household attributes, preferences and lifestyles should also be collected as part of this exercise.

4.1.3. Multi-Sited Ethnography Combined with In-Depth Traveller Interviews

Quantitative data inquiries should ideally be preceded and paralleled by collection and analysis of qualitative data. This is necessary not only to provide a full understanding of mobility experiences, barriers and motivations underlying the decision-making process of multimodal route, access, egress and transfer practices, but also to ensure that key questions are adequately identified for the quantitative surveys.

4.1.4. Document Analysis and Informant Interviews

Document analysis and informant interviews form an important research tool in mobility mapping through (i) examining documents and records relevant to regional and urban policy-packaging, and sectoral development decisions having spatial dimension and (ii) key-informant interviews. Use of documentary analysis has become quite popular in transport research, especially when we are trying to evaluate the impact of an initiative. For example, a national government led approach to increase access to health facilities. Key informants, including politicians, international funders, policy makers, humanitarian organizations, the local and regional authorities, ministry officials directly involved in decision making on sustainable transport, etc., should be engaged to shed light on the topic of mobility and its inter-sectoral development dimensions. These experts can provide valuable insights when making recommendations for solutions.

4.1.5. Exploring the Links Between Activity Participation and Subjective Well-Being

Concepts, terminologies and the will to explore linkages between the quality-of-life (QOL), subjective wellbeing (SWB) and daily travel have taken roots in the western research world in the past decade. This strand of research is primarily absent in the Global South. This could be partly due to lack of data for conducting robust studies to explore the relationship between QOL, SWB and daily travel. We propose that statistical methods like choice modeling, structural equation models, factor/cluster, etc. should be employed to identify and estimate the links between gender, daily travel times, time use, subjective well-being (SWB) and the extent to which the overall quality of life is affected by lack of access.

Studies based on similar approaches suggest important gender differences in activity participation, travel time, time use outcomes and resultant SWB [130]. They further find that travel times were unassociated with SWB for both genders. Instead, results were consistent with travel times serving as inputs in activity participation and therefore—at least for women—indirectly contributing to higher levels of SWB. These findings suggest that focusing on activity participation as a chief policy objective could yield higher quality of life benefits than a policy focus on travel time savings [130] (p. 10).

Transport planning in the Global South has been dominated by the logic of travel time savings, underpinning decisions on building highways, flyovers and road expansion programs. The field has simultaneously and consistently failed to serve a majority of the population. We therefore propose a

shift in the transport planning approach—shifting the focus from travel time reductions as the chief policy objective to a focus on activity participation, enhanced SWB and QOL.

Activity participation should ideally be analyzed at the macro, meso and micro levels and policies designed for these three levels should be interlinked and complement each other (refer Table 1).

Table 1. Typology levels.

Spatial Level	Methodology	Output
Macro-regional/city level	Mapping of interaction between land use and accessibility; app-based survey plotting the travel behavior, travel impedances, public transport route mapping, time use studies, mapping activity participation, personal interviews, ethnographic studies, document analysis and popular media discourse and history of planning to unearth biases.	Accessibility mapping; route mapping; time use mapping and mobility potential of women (and specifically low-income women)
Meso-zonal level	Questionnaire surveys, mapping activity participation, ethnographic studies and focus groups.	Accessibility levels to i. Work; ii. Education; iii. Social opportunities; iv. Health amenities and v. Training facilities.
Micro-ward level	Safety audits, walkability and bikeability audits; assessment of walking and bicycling infrastructure and mapping unsafe areas, routes, hotspots.	Micro-level information, which can be collated and scaled up. For ex. design interventions based on local conditions.

4.1.6. Accessibility Mapping

Continuing the above discussion, there is a dominance of the transport modeling approach based on the logics of travel-time savings underpinning the major transport infrastructure projects. Rarely is comprehensive land use and transport interaction (LUTI) models employed in the Global South to see the linkages between land use/activity participation and transport infrastructure provision.

We proposed that mapping of the interactions between accessibility with different transport modes to different land uses, and facilities like schools, employment and health centers, be undertaken for informing the design and implementation of transport infrastructure like public transport routes, bicycle network, etc.

In the following example, we presented a similar exercise for Bergen, Norway based on InMap (a simplified LUTI model), which links job accessibility by bicycle (and E-bike) and the land use plans (refer Figures 5 and 6). In this case, the supply of land was determined by the local municipalities through land use plans, while the demand for the land was estimated as a function of the accessibility to jobs, trade, general services and health services in the areas (from comparing E-bike accessibility with the land use growth potential, the authors found that it was possible to develop land use strategies to enhance the use of E-bikes. High job-accessibility with E-bikes close to the city centers supports the current general strategy of pursuing high density developments/transformation projects in these areas. The findings that the green field development areas were, in general, not found to provide any substantial accessibility with E-bikes).

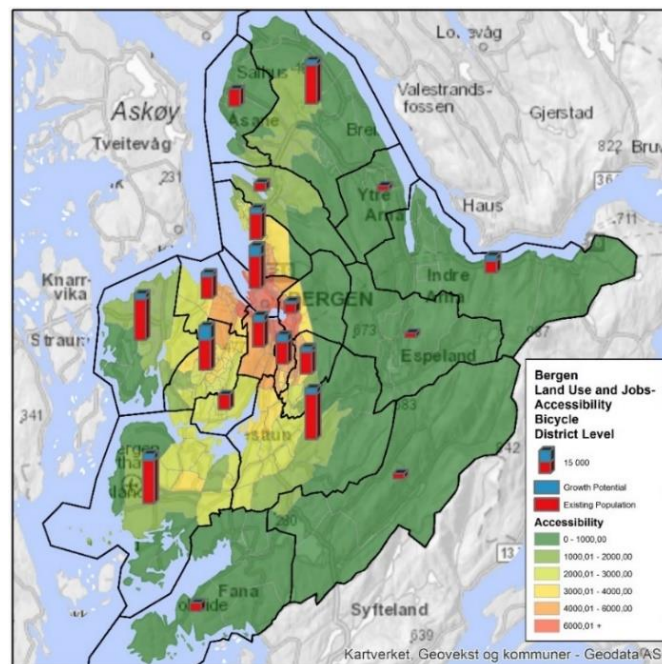


Figure 5. Accessibility with bicycle and growth potential, Bergen, Norway. (Source: [131]).

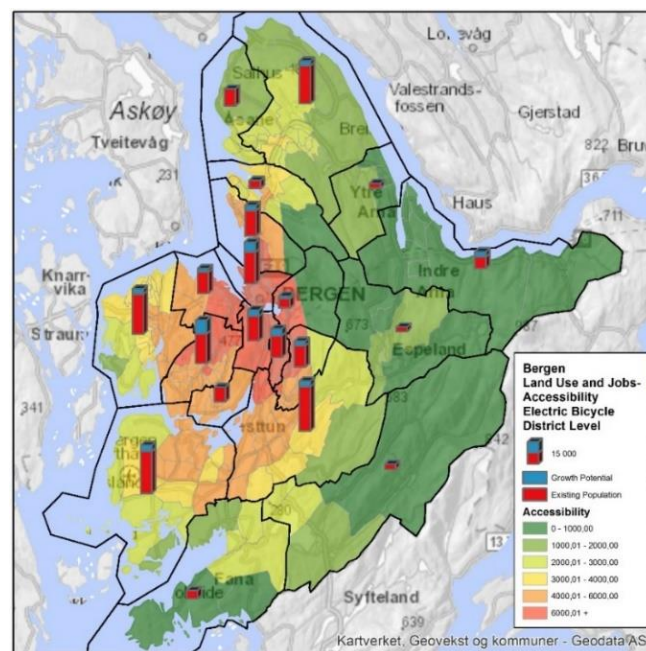


Figure 6. Accessibility with E-bike and growth potential, Bergen, Norway. (Source: [131]).

5. Research Gaps and Recommended Research Directions

The research gaps identified in this study deal with the following three components and the interface between these components: (i) Organization/governance, (ii) infrastructure provision and planning and (iii) travel (spatial) behavior culture/education. These three components can be further broken down to address the specificities of rural, urban and peri-urban areas. The relationship between gender and transport should underline all developmental policies—social protection programs, welfare policies, rural development, slum resettlement programs and urban planning policies. We comment specifically on the identified research gaps and research directions in the following points.

5.1. RESEARCH GAP 1: Inclusion of Gender from the Costs–Benefits Analyses, Which are Typically Used to Justify Investments Promoting Male-Biased Car-Based Urban Mobility

Research direction: How can we insert gender in the equation of costs–benefits assessments and other routinized protocols that are used for decision making?

Accessibility to employment, health and education opportunities have tangible, economic benefits. These numbers can be calculated, and easy to convert into economic indicators. If these indicators are taken into the cost–benefit assessments, then the chances of prioritizing transport infrastructure facilitating public transport, walking and cycling will be substantially increased.

It is of utmost importance that research findings are linked to policy making and program formulation. Currently, we have active research engagement on the topic of gender, transport and spatial planning in the Global South and yet the research findings are almost routinely ignored in policy making and seldom taken forward at the program formulation stage.

5.2. RESEARCH GAP 2: Acceptance of the Importance of (Affordable and Connected) Public Transport Provision for Facilitating Women in Transport Policy and Program Formulations

Research direction: What kind of capacity, knowledge and cooperation modalities need to be built to include both formal and informal public transport systems in the different hierarchies of transport plans?

How should we design specific programs on the tax structure for public transport and fund allocation to prioritize PT (Public transport)?

A most basic and simple message is to prioritize public transport over providing for cars. Informal public transport options like shuttle bus, jitneys, boda-boda, etc. should be included in the different hierarchies of transport planning from national, regional to local transport plans. Provide adequate tax benefit and subsidies to promote public transport. Address issues of unsafe running and operation of the informal public transport modes. Design policies to respond to the ‘special needs’ of women in terms of trip duration, access-egress, length, trip-chaining and trip purposes (with special reference to accompanying trips—traveling with children, elderly, etc.).

Research direction: How can we insert economic support systems in the welfare domain to address transport affordability issues for low-income women of the developing economies?

Affordability (and thereby accessing public transport) is a major impediment for low-income women. This is further compounded if the employment spaces of women living in slum and squatter settlements are hit by resettlement programs. Programs to address affordability issues needs to be sewed in with other welfare programs. Free public transport tickets, bicycles and other innovative solutions can have positive impacts on low-income women’s access to education, employment and health opportunities.

5.3. RESEARCH GAP 3: Focus on Efficiency of Formal Sector Mobility and Transport System Performance Takes Precedence over Provision for Accessibility to Services and Opportunities for the Informal Economy and Communities

Research direction: How to incorporate the transport needs for informal economy engaged in regional trade into formal regional transport corridor developments?

Research direction: How to fuse spatial development and relocation policies to cater to women’s opportunities with respect to education, health and employment?

Conduct accessibility mapping for different transport modes and prioritize areas for future growth that support walking and bicycling. In areas that are already built, create infrastructure that ensures safe walking and bicycling.

Further, it is vital that land use planning and development programs recognize and make space for informality, as informal markets provide the lion share of working space available to low-income women in both rural and urban parts of the developing world.

Route mapping and route planning of both the formal and informal public transport supply can aid in linking low-income areas to the employment and education hubs.

Develop toolkits for the incorporation of informal economy engaged in cross-border flows into regional transport corridor planning

5.4. RESEARCH GAP 4: Integration with Other Sectors is Missing—Transport is Operated as a Separate Sector without Recognizing its Deep Connections to the Health, Employment and Education Domains

Research direction: How to frame a multi-sectoral approach—ensure the mobility for women (both urban and rural) to ensure their access to employment/markets, education and health centers?

Link policies of other social development sectors with the transport sector. Welfare and social protection programs can be built around the issue of access to promote access to education, health and employment (refer to the cycling program of Bihar, India).

5.5. RESEARCH GAP 5: Lack of Clear and Visible Efforts to Map and Address Safety Concerns and Incidences of Women on the Move

Research direction: What are the exact policies, programs and tools needed to enhance women's personal safety? How to design more gender-sensitive public transport, walking and cycling space?

Safety is a major concern for women. Spatial and transport projects need to prioritize creating safe spaces at both macro and micro levels. At the macro level, smart solutions like Safetipin apps and safety auditing routines can be employed to map unsafe areas. Mapping without following up will be a wasted endeavor. Protocols need to be established on how to transform these unsafe areas, routes, etc. into safe, accessible areas [132].

At the micro level, for example, for spaces within the public transport, bus drivers and bus conductors need to be trained to deal with situations of sexual harassment. When the driver or conductor themselves are found to be culprits, punitive measures need to be in place for dealing with such actions [133].

Further, there exists a strong need for putting more emphasis on non-work related travel issues concerning trips made for care, household and household-based industry works.

5.6. RESEARCH GAP 6: Labour Issues—Social Protection Programmes are not Linked with Employment in the (Informal) Transport Sector and Lack of Efforts to Address Male-Dominance in the Transport Sector Workforce

Research direction: How can we encourage more female participation in the spatial planning and transportation sector?

How can the stigma and discrimination associated with women in the transport industry—especially in roles like driver, conductors, etc.—be tackled? How can laws that restrict women's participation in the transportation sector be removed?

Women face high levels of discrimination to both enter and work in the transport sector, which is often supported by restrictive laws in some developing countries (refer Figure 7).

Typically, women are either absent or marginally present on the different levels of transport domain. Actively encouraging and engaging women in the transport field, through targeted programs, can have major impact on the future of this field. The current transport field has blatantly ignored the needs and preferences of women, which may be corrected through inserting women in this sector. A first step could be to collect data on female employment both in the formal and informal transport sector and chart out ways to protect these workers through social protection programs.



Figure 7. Legal restrictions on women’s employment in the transport sector (Source: [134]) Note: Ukraine removed restrictions after the data collection period ended.

5.7. RESEARCH GAP 7: Lack of Smart City, Smart Solutions Research from an Inclusive Perspective

Research direction: How can we design smart mobility and smart-city solutions to create inclusive settlements?

Smart cities and smart mobility solutions have changed the ways in which urban areas are being planned, utilized and consumed. It is vital that the element of inclusive settlements is inserted in this development on an immediate and urgent basis to avoid further pitfalls. Questions like who has access to these solutions? Who are the current users? How can we facilitate access to the other groups? What kind of solutions are needed? Are solutions based on bottom-up feedbacks? etc. needs to be routinely asked, monitored and fed into design solutions.

5.8. RESEARCH GAP 8: Lack of Simple, Standard Indicators

Research direction: How can the findings emerging on gender and transport be supported by simple (and non-complex) indicators for the benefit of policy makers?

How can programs like the results-based budgeting technical assistance (TA), which the World Bank has adopted in the field of Health Planning, be designed and developed in the field of transport planning in the developing economies?

The knowledge generated through periodic assessments and estimations of the macroeconomic and welfare effects of creating accessible (education, health and employment) opportunities, could potentially benefit two important groups of policy makers and government stakeholders—(i) officials responsible for infrastructure evaluating road construction programs as economic investments and (ii) welfare sector officials focused on promoting gender equality, social development and poverty reduction. For the first set of officials, core area of interest revolves around the relationship between the provision of road infrastructure and national income growth as measured by GDP metrics while the second group is interested in social development outcomes. These two analytical perspectives are seldom brought together to complement each other. Through creating the simple, standardized and context-informed methodology for the measurement of economic and social impact of road building and other transport intervention programs, both sets of policy concerns can be monitored.

Simple indicators, however, run the risk of oversimplifying situation, yet they hold the potential for providing an overview to the policy-makers. Indicators should be developed and routinely used,

but subjected to periodical assessment and upgrading, based on both quantitative and qualitative assessments and contextualization.

5.9. RESEARCH GAP 9: *Traffic Accident Data is Under-Reported and not Sex Disaggregated*

Research direction: Collect sex-disaggregated data on traffic accidents, which should include all forms of mobility—walking, cycling, public transport and car-based accidents.

Pedestrians form the biggest group who get either seriously injured or die in traffic accidents. If we analyze the predominance of walking among women in the developing countries, it will be no surprise that a greater number of (pedestrian) women might be dying in traffic accidents and yet a sex disaggregated analysis of traffic deaths remains unavailable. Disaggregated data analyses can assist in answering questions on the spatiality and temporality dimensions of the accidents—where (locations) and when (time) are male and female respectively meeting accidents?

5.10. RESEARCH GAP 10: *Unpacking the Linkages Between Feminization of Informal Settlements, Relocation and Livelihood Opportunities*

Research direction: Collect sex-disaggregated data on livelihood issues in light of relocation.

Informal settlements are increasingly becoming feminized with a relatively higher concentration of females than males living in slums in the developing world. Relocation decisions impact livelihoods of women to a much greater extent than men. Access to employment opportunities that suits the livelihood profile of slum women is hardly ever brought forth in relocation decisions. The interconnection between livelihood and spatiality needs to be out in focus.

5.11. RESEARCH GAP 11: *Knowledge on Mobility Options and Cross-Border Trading*

Research direction: A few of the research areas that should be further investigated while designing regional transport corridor schemes are as follows:

- What are the inter-linkages between transport provision (both hard infrastructure and gendered access to the transport resources), value chains and gender inequality?
- What are the main mobility challenges and opportunities for women entrepreneurs in the context of cross-border trade?
- What are the potential ways of improving regional mobilities?
- What are the potential ways of integrating gendered mobilities concerns into value chain of development projects and programs to assist women in maximizing their profitability and competitiveness?

6. Conclusions

We have looked at the specificities of women's mobility and its implications for transport planning along with urban, regional, rural and social planning. We posit that the multiplicity of the issues involved in understanding a complex topic like gendered mobilities with both its traditional and emerging 'smart' variant necessitates that we borrow and build on a host of theories and analyses. To that end, we have used a combination of socio-psychological and feminist theories, socio-technical transition theory, mobility biographies and social practice theory framework to frame a discussion around the differentiated patterns of women's transport needs, usage and implications for future planning.

Currently, the transport sector in the Global South is becoming aware of the environmental consequences but is grappling with how to balance the development and the environmental agenda. Given this scenario, government agencies would do well to understand how the environmental meaning operates. If environmental meaning is a better retention mechanism than a recruitment mechanism, then appeals to environmental sustainability or reduced carbon footprint are not likely to change user behavior. Determining effective mechanisms for recruitment to sustainable mobility is an important agenda and our analysis reveals that women could be champions here. They exhibit

sustainable travel behavior and yet continue to be ignored. Transport systems will benefit greatly by becoming gender-responsive as the sector can then simultaneously cater to the three pillars of sustainable development—environment, social and economic pillars. As an initial step, it would be useful to have a simple and overarching framework that underlines the relevance of transport to women's employment/livelihoods/income security and unpaid domestic care work (i.e., 'production' and 'reproduction'). In other words, mobility/transport are needed to facilitate women's access to markets and jobs and to facilitate their access to services (e.g., health centers, schools, childcare centers, shops, etc.). Additionally, the transport sector itself can be a source of employment for women, contributing to becoming a source of livelihood but more essentially, influencing the norms dictating the field of transport at large to be more mindful of women's needs and preferences. Traditionally, the norms governing the transport sector remains heavily male dominated in terms of both employment and a technical orientation. Issues regarding safety, affordability, accessibility, availability, acceptability and accommodation are vital and need to be taken into transport design and planning.

The transport field is undergoing huge transitions both from a policy perspective with added impetus of Agenda 2030, and practice perspective with insertions of smart solutions. In light of these developments, the policy focus is actively promoting a shift from car-based daily mobility to a more sustainable one. However, given the prevalent 'norms' in the transport field, focus on 'hard' infrastructure persists and social-psychological elements benefitting women's daily mobilities are routinely ignored. Practice theory, for example, could be employed here to highlight and explain user adoption of innovations and provide for a richer understanding of the micro-phenomena that takes place on different life stages by which these stages can be targeted in the right manner. In light of the social (sustainable) practices adopted by women at large, the process of recruitment/defection and retention/reproduction needs to be better understood. In the parlance of practice theory, how a practice such as walking, bicycling and public transport usage can undergo formation and reformation in a manner that it can sustain itself needs to be studied.

The ways in which different groups of women engage with different forms of mobilities vary according to the life-stage, conditions and contextual circumstances. This set of knowledge, on user variations, offers tools for promoters with which the sustainable practices of majority of women can be upscaled to a mainstream or dominant practice of daily mobility. The relationship between user and promoter circumstances and conditions is not static, but co-evolutionary. Promoters respond to how users actually use their products and services, and, in this regard, every transport decision needs to be unpacked and scrutinized as a product delivery with an open discussion on who constitutes the target customers. These analyses, for example, can be used to bolster the agenda of creating the walking- and biking-friendly cities.

Further, the authorities need to seriously engage with the foremost issue of 'How to make data collection and analyses routinized processes?'. Links between transport and housing policies should be inserted in land use, housing and relocation decisions. The research gaps identified so far highlight that very few studies have looked at the interactions between urban housing policies and accessibility wrt subsidized housing, establishment of resettlement colonies and loss of livelihoods of women.

Studies on governance and cross-border trade should discuss ways in which firstly, informality is recognized and secondly, the transport sector is restructured to facilitate women's employment both within and outside the transport sector.

Additionally, how can the transport sector engage with women's organizations to hear their needs and demands? Such analyses should be carried at micro, meso and macro levels to ensure that local, regional and international (wrt cross-border trading) markets are available to women for expanding their capabilities.

From a methodological perspective, a multi-method approach (e.g., [135]) should be adopted to integrate both qualitative and quantitative data in knowledge generation and decision making. Plotting of existing data on travel behavior and survey data on individuals' subjective and self-reported preferences, acceptance of different mobility options, and attitudes related to the adoption of the

proposed solutions can be a suitable starting point. An easily accessible way to move forward would be through creating predictive scenarios of travel behavior by interlinking demographics data with travel behavior. Such interlinking should be augmented through identification of major trends and driving forces in the past and projections for future. Along with mapping out the gender effects, these scenarios could be used to discuss and assess the environmental, social and economic impacts of the projected travel behavior and future mobility. For the regulating and implementing agencies, such scenario assessments will map out the opportunities and challenges involved in formulating policies and programs to reach sustainability goals and assess the scale of the required changes. Ways to sew this knowledge into the specifics of designing social protection programs or niches for transition demands further exploration. The case of the Cycle program for rural students in the state of Bihar, India is an excellent example of such a niche.

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