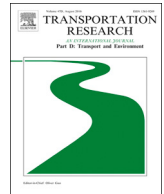


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Area- and gender-based commuting differentials in India's largest urban-rural region

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ABSTRACT

In the countries of the Global South such as India, rapid urbanization and the increase in individual motorization may lead to a predominance of unsustainable commuting patterns. However, urbanization also has important positive effects, including the empowerment of women. This paper examines newly released, spatially disaggregated data on home-to-work commuting by non-agricultural workers in the National Capital Region of India. It aims to understand and compare commuting patterns in urban and rural areas, including choice of travel modes, commuting distances, and gender differentials.

The results reveal a tendency observable in urban residents to use individual motorized transport more often both for short and for long trips, although the proportion of individual motorization is far from what it is in the industrial world. Rural areas are characterized by the predominance of non-motorized travel modes and a large share of long trips. The mobility gap between men and women does not appear to increase with literacy. In urban areas, women often choose to commute by car rather than using green modes of transportation (especially in higher-income districts). The paper stresses the importance of the area and gender differentials that need to be taken into account when formulating regional transport policies.

1. Introduction

In the last few decades, India has experienced rapid economic development and urbanization. The concentration of employment opportunities in and around major urban centers has not only given rise to rural-urban migration but also to increased commuting on the part of workers, some of it over long distances (Sharma and Chandrasekhar, 2014). Industry relocation towards urban peripheries has added further impetus to commuter flows in the working population (Ghani et al., 2012). The changes in individual mobility patterns (the use of motorized and non-motorized transport) induced by urbanization are posing new challenges for India while at the same time opening up new opportunities.

On the one hand, India is the world's fourth largest emitter of greenhouse gases (GHG), and 13% of its emissions stem from the transport sector (Dhar and Shukla, 2015). Increased traffic induced by urbanization may lead to heightened GHG emissions from transport, and regular commuting to work could become one of the main sources of these emissions. According to the last census (CoI, 2011b), over one third of all trips to non-agricultural jobs in India are undertaken on foot or by bicycle, and roughly one quarter are undertaken using public transport. Economic growth and the attendant increase in individual motorization may however change this situation quite quickly, leading to a prevalence of environmentally unsustainable mobility patterns (Li, 2011). To avoid the traps the

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industrial world has frequently fallen into over the past few decades, these unsustainable mobility patterns have to be identified and addressed as quickly as possible.

On the other hand, urbanization can increase the range of economic opportunities for disadvantaged groups in India, notably women (Tacoli and Satterthwaite, 2013; Manon and Sukumaran, 2015) because it makes for a greater variety of jobs. It enables a large number of women to work in the expanding and increasingly feminized manufacturing and service sectors (Lee, 2017). To a certain extent, light can be cast on these processes by information on commuting habits. Accordingly, the study of commuting patterns differentiated by gender and area type (rural or urban) is a crucial precondition for the success of policies attempting to achieve social justice and gender equality.

Employing descriptive statistics and regression analysis, the present article examines the newly released, spatially disaggregated data from the Census of India on regular home-to-work commuting by non-agricultural workers. The aim is to achieve a detailed understanding and comparison of commuting patterns and their determinants in urban and rural areas, including choice of travel modes, commuting distances, and gender aspects. The findings are compared with the outcomes of previous studies on India and with information from other contexts.

The study focuses on the National Capital Region (NCR) of India. With a population of 58 million, it is one of the world's largest rural-urban regions (Jain, 2017). There has been a recent policy focus in India and in the NCR both on transport sustainability (NCRPB, 2013: 79, 57) and on inclusive planning with an emphasis on the gender dimension of the 'shelter-transport-livelihood link' (MoUD, 2014a: 20). Accordingly, the research that has gone into the present study comes at a particularly apposite juncture.

We set out to answer the following questions: (1) What patterns of home-to-work commuting are discernible in the NCR? (2) What factors determine travel-mode choices and commuting distances? (3) Do socio-economic and geographic factors affect the commuting patterns of women and men differently? (4) What factors favor the predominance of sustainable types of travel? (5) What are the implications for policies aiming to angle developments towards sustainable and inclusive mobility?

The paper is divided into five sections. This introduction is followed by the literature review. Section 3 contains the description of the study area, the research methodology, and the data. The fourth section presents the key findings and discusses them. Section five concludes.

2. Literature review

2.1. Structure of commuter trips

Compared to the vast body of empirical literature studying travel behavior and, in particular, commuting patterns in countries of the industrial world (White, 1986; Button, 1997; Banister, 2005; Chapman, 2007; Crane, 2007), similar literature for India is still comparatively scanty, largely due to data availability issues. Recent studies either focus on a specific city (Munshi, 2013; Shirgaokar, 2014; Goswami et al., 2015; Mahadevia and Advani, 2016; Manoj et al., 2015; Pathak and Shukla, 2016; Suman et al., 2017) or use surveys or statistical data covering a sample of settlements (Sudhakara Reddy and Balachandra, 2012; Sharma and Chandrasekhar, 2014; Gupta, 2016; Ahmad and Puppim de Oliveira, 2016; Tiwari et al., 2016). Comparisons between urban and rural areas are conspicuous by their absence (Sharma and Chandrasekhar (2014) is one exception). Prior to 2011, the Census of India did not contain any relevant data on commuter behavior.

The findings produced by this literature indicate many important aspects, notably the differences between commuter patterns in India and the patterns characteristic of the industrial world. One important finding is the high proportion of non-motorized transport (NMT) in Indian cities (Tiwari et al., 2016). Usually, however, non-motorized travel modes such as walking and cycling are not the alternatives of choice. Commuters resort to them because other modes of transport are either absent or unaffordable. In this connection, some authors speak of 'captive' NMT users (Tiwari, 1999).

At the same time, the motorization rate has been growing exponentially, albeit from very low initial levels (Li, 2011). The use of cars and especially two-wheelers is increasing particularly fast in those cities that do not have an established public transport system (Tiwari et al., 2016). Between 1991 and 2011, the total number of motor vehicles registered in India increased from 21 million to 142 million and that of two-wheelers from 14 million to 102 million (MoUD, 2014b: 6). These major increases have generated warnings both about future GHG emissions (Bose et al., 2001) and about the future economic advancement of Indian cities (ADB, 2006).

The recommended strategies for countering such unsustainable trends in the countries of the Global South usually include the development of energy-efficient and smart public transport, support for electromobility, stepping up incentives to use public transport and NMT (via infrastructure investments and taxation on non-sustainable travel modes), and mixing land use in urban areas (Dhar et al., 2013). The problem of long-distance commuting from the rural areas to the urban centers cannot be readily solved without creating better local employment opportunities on the periphery. In this connection, priority should be given to investment in rural transport infrastructure and the provision of rural roads (IDFC, 2013:120).

2.2. Gender differentials

The literature on gender aspects in transportation is growing worldwide. It emphasizes that the travel patterns of women continue to differ from those of men, the main reasons being income disparities, persisting gender roles, cultural norms pertaining to appropriate transport behavior, and safety concerns (Peters, 1998; Rosenbloom and Plessis-Fraissard, 2009). In many instances, this leads to transport inequality and the social exclusion associated with it (Church et al., 2000; Levy, 2013), a phenomenon that is especially pronounced in the Global South (Babinard and Scott, 2009; Levy, 2009; Roy, 2009). This research literature underlines the

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