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Assessment of the potential for modal shift to non-motorised transport in a developing context: Case of Lima, Peru

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ABSTRACT

Under the logic of Avoid, Shift, Improve, fostered by donors and NGOs worldwide, cities in the global south are investing emphatically in non-motorised facilities and policies for low-carbon mobility aiming to reduce the adverse environmental impacts of urban mobility. Such is the case of Lima, Peru, our case study. Through the analysis of the potential for integration of non-motorised facilities with current and planned public transport networks, we seek to provide evidence on the planning considerations of non-motorised facilities in Lima with an emphasis on multi-modal travel and integration of non-motorised infrastructure. We develop spatial coverage, capacity and accessibility assessment of the 'supply side' of the transport network. In addition, the research studies the local transport system and travel patterns to identify trips with the potential to shift to non-motorised alternatives. Based on these analyses we estimate indicators of potential coverage, changes in mobility patterns and distributional effects of current investments. Our analysis suggests that coverage of high-capacity public transport can potentially increase by up to six times if integrated adequately with cycling facilities. The research provides methodological and empirical contributions to debates related to the capacity of cities in the global south to adopt low-carbon mobility in the foreseeable future.

1. Introduction

Developing cities are increasingly pursuing initiatives supporting modal shifts toward sustainable modes of transport, aiming to achieve reductions in adverse environmental impacts associated with urban mobility. Under the logic of Avoid, Shift, Improve, fostered by donors and NGOs worldwide (Dalkmann & Brannigan, 2007; Tiwari, Cervero, & Schipper, 2011), cities in developing countries are investing emphatically in non-motorised facilities and policies for low-carbon mobility. Such is the case of the metropolitan area of Lima, Peru.

This paper examines the potential for integration of motorised and non-motorised modes of transport in the metropolitan area of Lima, which includes the municipalities of Lima and Callao. Such an examination stems from the premise that all existing transport modes play different and complementary roles in shaping the mobility and accessibility of the city (Rietveld, 2000). However, in the light of rising concerns over sustainable development, the need to increase access to opportunities and services for urban populations is constrained by the need to reduce emissions of greenhouse gases. In this context, some strategies, such as the promotion of public transport and non-motorised travel, are regarded as more efficient than others in addressing mobility needs (Litman & Burwell, 2006).

The value of modal integration lies in understanding the comparative advantages of transport modes to combine their use in a way that addresses the accessibility needs of the population whilst responding to other sustainability objectives. Hence the importance for a city like Lima, which has a large range of modes, to create a system of integrated transport modes that covers 100% of the city's travel demand with good-quality service (affordable, accessible and convenient). In that context, non-motorised modes play an important role for short distance trips as they generally have a much lower environmental impact and have complete flexibility in terms of timetables and route design (Giles-Corti, Foster, Shilton, & Falconer, 2010; Walsh, Jakeman, Moles, & O'Regan, 2008). In contrast, mass transit modes, which are rigid in both the layout of the routes and their operation, work very well for medium and long distances and have relatively low environmental impact per user, depending on the technology. In Lima, the challenge to promote sustainable mobility relates to defining

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conditions of transport planning and urban design to ensure comfort and ease of transfer between the different modes of transport, public and private, to construct an integrated transport system. The objective is to provide conditions for affordable, convenient and enjoyable door-to-door trips, reducing, whenever possible, monetary costs (public transport fares) and time, and improving comfort.

The concept of transport integration and multimodal travel is not necessarily new (Kenyon & Lyons, 2003). To some extent all urban trips, apart from walking trips, are multimodal, especially those made on public transport, as they involve a segment (i.e. between the door and the vehicle) to be completed on foot. However, multimodal transport is challenged by the degree of integration, the cost of transferring between modes and the valuation, either positive or negative, that users place on such costs. Users' valuation of costs is highly dependent on the financial 'out of pocket' cost, but also on the convenience and ease of making the transfer in terms of impact on the overall trip (e.g. percentage of travel time invested in the transfer). For example, in most cases of integration between 'walking' and 'private vehicle' modes, the cost of the transfer seems negligible to the point that most people would not consider such a journey as intermodal. However, under the assumption that this is an intermodal trip with at least one transfer, a low or non-existent perceived transfer cost can be explained by the provision of urban facilities that make this integration convenient and comfortable. In other words, for trips in private cars, transfer costs are drastically reduced by the provision of a large supply of parking facilities at very short distances from the point of origin and destination and at a relatively low or non-existent price.

Given the potential of fostering non-motorised infrastructure as a measure to mitigate environmental impacts of transport and positively impact on urban development and accessibility, our research focuses primarily on identifying the potential of integrating non-motorised trips (bicycle and walking trips) with mass transit modes (metro system and bus rapid transit system). We build on data from the household mobility survey conducted as part of the update of the city's Urban Transport Master Plan (JICA, 2012). A geospatial analysis of the survey data was conducted in specific nodes or geographic areas of the city where various modes of transport operate simultaneously without integration. Subsequently, other conditions associated with transport supply, demand and land use characteristics were analysed under a multidimensional framework for assessment of the current potential for integration, as well as the constraints and opportunities for its consolidation and expansion.

2. Objectives and methodology

The aim of this research is to identify the areas in the municipalities of Lima and Callao that have characteristics that can potentially favour or ease the physical integration of mass public transport modes and non-motorised modes. We define physical integration as the conditions at the facility level that enable 'seamless' transfers between modes. To identify the potential for integration we will construct a multidimensional analysis (Zuidgeest et al., 2009) to define a general characterisation of Lima's transport network infrastructure, its travel patterns and trip segments and its urban services. Based on the analysis, preliminary integration points or areas will be identified.

Our analysis builds on secondary databases that include the 2012 Origin-Destination survey for the city of Lima, geostatistical information about the transport network, non-motorised infrastructure, land use and socio-economic figures.

2.1. Lima's transport planning context

For a decade, the transport system of the metropolitan area of Lima has experienced significant changes in its structure, organisation and services. In particular, mass transit modes (Metropolitano – the BRT Line – and the first metro line) were implemented recently. Between 2011 and 2014 the administration of the metropolitan municipality of Lima started the process of restructuring the traditional transport services operating in the city's main transport corridors. This restructuring of services is aimed at categorising corridors by hierarchies and, consequently, assigning different types of routes. The restructured services are planned to be integrated with the mass transit lines of the BRT and the metro system to complement the service. The improvements started in mid-2014 with interventions in one specific medium-capacity corridor. The operational changes in the corridor resulted in positive and negative outcomes in terms of quality of service and customer satisfaction. Nonetheless, these new measures marked the start of the gradual implementation of the city's Integrated Transport System (ITS). In addition to the restructuring of traditional services, other projects are being developed to improve pedestrian and cyclist mobility, organise and regulate taxi services and improve traffic flow conditions. Fig. 1 presents mass transit infrastructure, feeder routes and existing cycle lanes for the city of Lima (see Fig. 2).

The context of the metropolitan area of Lima presents both opportunities and challenges for further development and implementation of initiatives to promote the use of non-motorised transport. In principle, the opportunities are related to: i) favourable topography as the city's main geographic area is on a plain; ii) favourable weather without extreme temperatures and limited rainfall throughout the year; iii) average trip distance (all modes and purposes) of around 7.5 km according to the Urban Transport Masterplan; iv) low motorisation rates with only 16.5% of households owning a private vehicle (ENAHO) and relatively high bicycle ownership with 30% of households owning a bicycle; and v) 126 km of cycle lanes already in place by 2013 and cycle parking facilities available inside three of the metro line stations and inside the BRT system main stations and in the surroundings of other BRT intermediate stations. Challenges are related to the distribution of the potential benefits as it is likely that the low-income population will not perceive the mentioned benefits as they inhabit mostly the areas on the hills at the city's periphery, which means that their trips are likely to be much longer than the average, with segments on steep roads and without adequate infrastructure for non-motorised modes. Challenges also arise in areas where infrastructure for non-motorised modes is already in place due to issues such as poor connectivity, lack of maintenance (in the case of cycle lanes and pavements) or limited access (in the case of cycle parking). Moreover, despite mild temperatures, because of the limited amount of greenery to provide natural shade, sun exposure can be perceived by users as a barrier to cycling and walking during the warmest months.

2.2. Methodology

Our objective is to understand the conditions under which Lima's transport system could be used more efficiently in order to reduce greenhouse gas emissions. Hence, the analysis focuses primarily on the integration of non-motorised modes with the mass transit systems (metro and Metropolitano –BRT line – in Lima). The analysis also considers the integration of mass transit and traditional modes such as buses, taxis and motorcycle taxis, based on the potential modal shift from these modes to non-motorised modes for short (feeder) trips. This assessment of integration

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