Transport Poverty in Thailand: Concept, Measurement and Data Availability

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Abstract: Transport poverty is not only a term used to accentuate the fact that some groups of population in the society are unable to commute as they need, but the concept is being studied by researchers to accurately locate and identify the disadvantaged, who would need to be considered in transport policy and decision making. Due to its complexity, conceptualization and measurement of transport poverty have not always been clear and comprehensive. As measurement of transport poverty usually requires a specific set of data, developing countries are generally regarded as potentially having insufficient data. Thailand’s social and economic context imply that the issue has been present in the country while availability of data required for its measurement is unconfirmed. This paper reviews and discusses how the concept has been defined and measured by some previous research as well as availability of Thailand’s data applicable for various types of measurement. The results show that existing data would permit certain types and degrees of measurement; nonetheless, a more precise and accurate measurement of the issue would require more complete data sets.

1. INTRODUCTION

In today’s world where economic boundaries have greatly expanded beyond a walking distance, people need some forms of transport in order to take part in activities in the society, but many times they would also have to bear various types of disadvantages. People who avoid highly-priced accommodation in the city centres must live in suburban areas, far from economic and employment opportunities. While housing in suburban areas might be more affordable, public transport provision and job opportunities are often low, causing people living in the area to become car-dependent and sometimes forced to own a car (Stanley & Stanley, 2017). As public transport provision is challenged by the increasing trip distance caused by low urban density, it is not always possible to provide service to everyone, and sometimes public transport is not an affordable option for the low-income earners. Those living in urban settings also face their own types of issues. Motorized vehicles generate air pollution and traffic congestion. The poor in urban areas are likely to encounter more severe problems such as poor accessibility to services, low public transport affordability and lack of footpaths, which are often overlooked by policymakers Starkey and Hine (2014). These are examples of transport-related disadvantages studied by
groups of researchers under the concept of ‘transport poverty’ and some other terms.

An appropriate and accurate measurement of transport poverty would reveal specific areas or individuals that need to be paid careful attention to when transport policy decisions are made, and ultimately to promote social equity in a manner whereby more people in the society are able to make a journey as they need. In developing countries where data sources for measurement might not be ample, it is questionable whether available data will be enough for a type of measurement.

Thailand’s historical data indicate high susceptibility to the problem of transport poverty. However, there seems to be a limited amount of research related to transport poverty, and probably none of it directly discusses the issue of transport poverty (Further discussed in Section 5).

This paper seeks to provide a review of how previous research has conceptualized the term ‘transport poverty,’ how the problems of transport poverty were measured or assessed, and the availability of Thailand’s data for researchers or government to perform such measurements or analyses. As mentioned by Lucas et al. (2016), studies on transport poverty are not sufficiently put into real practice, the author hopes that this paper will provide some foundational information and analysis for researchers and related government agencies, not only in Thailand but anywhere in need of a guideline that bridges academic research and policy practice.

This paper is divided into seven parts. Some background information and motivation behind the study are included in this section. In the next section, methodology and data used in this paper are described. Recent studies on conceptualization of transport poverty are presented in Section 3. Empirical studies on the measurement of transport are introduced in Section 4. Section 5 provides background information of the situation of transport poverty in Thailand, previous studies related to the issues, and data availability. All findings of the review are discussed in Section 6, before the paper is concluded in Section 7.

2. METHODOLOGY AND DATA

This paper adopts a narrative literature review as the methodology to provide an overview of the current knowledge of transport poverty in terms of conceptualization and measurement, and the situation of transport poverty in Thailand, including availability of data and possibilities for measurements and analyses.

Research on conceptualization of transport poverty reviewed in this paper were found using the search term ‘transport poverty’ in three online databases: Google Scholar, Web of Science and ScienceDirect. To find empirical studies on measurement of transport poverty in addition to the sources cited in the works on conceptualization, related search terms such as ‘mobility’, ‘accessibility’, ‘affordability’ and ‘transport externalities’ were also used in mentioned online databases. The search term ‘Thailand’ was added to find previous studies in Thailand. The term ‘Bangkok’ was also added as the majority of the studies were found to be done in Bangkok and its metropolitan area.

Availability status of secondary data to be used for measurement of transport poverty in Thailand are found in the websites of potential
government agencies such as the Ministry of Transport, the National Statistical Office of Thailand and other public sources.

3. CONCEPTUALIZATION

The term ‘transport poverty’ revolves around types of transport-related disadvantages faced by individuals or households, yet it seems that researchers have not yet agreed on how transport poverty should be defined and how we can consider who or which households are in transport poverty. Transport poverty is often compared to a similar concept, fuel poverty, which is rather clearly defined (Mattioli, Lucas, & Marsden, 2017). Definitions such as ‘a household is considered to be fuel poor if they were required to spend more than 10% of their income on fuel to maintain an adequate standard of warmth’ (Department of Energy and Climate Change, 2014), or ‘a household is considered to be fuel poor if they have required fuel costs that are above national median level and would be left with a residual income below the official poverty line spending that amount’ (Hills, 2012, 2011), are widely accepted as the definition of fuel poverty. Referring to the former definition of fuel poverty, the RAC Foundation considered households spending more than 10% of their income on transport as households in transport poverty (RAC Foundation, 2012).

The term ‘transport poverty’ is reported to be used by media, organizations and government to sensitize the fact that some individuals and households are having a hard time or cannot travel as they need (Titheridge et al., 2014; Crisp, Gore, & Mccarthy, 2017). Transport-related problems that usually follow the term transport poverty are car affordability and high costs of public transport (Titheridge et al., 2014).

Acknowledging the complexity of the concept, Lucas et al. (2016) proposed that transport poverty was an overarching concept consisting of a set of inter-related sub-concepts and developed a lexicon of all sub-concepts of transport poverty as follows:

‘Transport affordability – inability to meet the cost of transport

Mobility poverty – the lack of transport

Accessibility poverty – the difficulty of reaching certain key activities such as employment, education, healthcare

Exposure to transport externalities – the disproportionate negative exposures to the transport system itself.’

Based on how they conceptualized transport poverty, a new definition was also proposed:

‘An individual is transport poor if, in order to satisfy their daily basic activity needs, at least one of the following conditions apply.

- There is no transport option available that is suited to the individual’s physical condition and capabilities.
- The existing transport options do not reach destinations where the individual can fulfil his/her daily activity needs, in order to maintain a reasonable quality of life.
- The necessary weekly amount spent on transport leaves the household with a residual income below the official poverty line.
- The individual needs to spend an excessive amount of time travelling, leading to time poverty or social isolation.’
- The prevailing travel conditions are dangerous, unsafe or unhealthy for the individual.’

Other studies that have attempted to develop a definition or a threshold to identify the individuals or households with transport disadvantages often focus on one sub-concept of transport poverty proposed by Lucas et al. (2016). Cain and Jones (2008) defined an affordability poverty threshold as ‘the average proportion of income spent on motoring by households in the lowest three income deciles.’ Titheridge and Solomon (2007) attempted to establish ‘minimum standards for access to activities’ using a focus group of older people and lone parents. Davis et al. (2018) developed the ‘minimum income standards for households’ to identify the minimum household income for its minimum acceptable standard of living. Currie et al. (2009) attempted to identify areas at risk of ‘transport disadvantage’ by finding relations between spatial location and the quality of public transport systems in terms of accessibility. Stokes and Lucas (2011) described ‘transport wealth’ as ‘the transport and accessibility opportunities available to people – in terms of access to modes (car, bus, rail, etc.), and to the ability to reach services on foot.’ Martens and Bastiaanssen (2019) defined accessibility poverty risk as ‘a situation of low accessibility that severely restricts a person’s ability to participate in the activities deemed normal in a particular society’.

4. MEASUREMENT

Despite no clear consensus on the definition of transport poverty, there were several studies attempting to measure the level of transport poverty. Frequently, results were either area-based indicators implying the level of transport poverty within a geographical area or identification of segments of the population at risk of transport poverty. To illustrate how transport poverty was measured, some of the empirical studies focusing on the measurement are presented in Table 1. Sub-concepts proposed by Lucas et al. (2016) are used to categorize the research into five groups: accessibility, affordability, mobility, exposure to externalities and composite measure, for a measurement that covers more than one sub-concept. Some of these studies have already been mentioned and discussed by literature on conceptualizing transport poverty. However, they are again discussed in this paper in order to provide more details of data used by policymakers who aim to put these measurements into practice or incorporate them into policy decision making.

Accessibility measurement was commonly achieved by creating an index or score of accessibility to services such as jobs and public transport from home locations. Two services of which accessibility was often studied by researchers were public transportation (Delmelle & Casas, 2012; Jaramillo, Lizárraga, & Grindlay, 2012) and jobs (Allen & Farber, 2019; Pojani, Boussauw, & Pojani, 2017). Job accessibility could be measured using street network data and Geographic Information Systems (GIS) or data from face-to-face interviews. More insights beyond the level of accessibility could also be gained based on the data used. For instance, Allen and Farber (2019) assessed the socio-economic status of each census dissemination area and mapped them against accessibility score. The population in the lowest quantiles of both criteria was deemed at risk of transport poverty. Pojani, Boussauw, and Pojani (2017) assessed relationships between gender equality, transport poverty and access to employment, using detailed information of sampled females gained through a survey questionnaire.
Jaramillo, Lizárraga, and Grindlay (2012) assessed the disparities between transport provisions and transport social needs using variables such as private vehicle ownership, unemployment, socio-economic situation and disabilities, using statistical data from the national statistical agency.

Mobility measurement often resulted in identification of groups or segments of the population having difficulty to travel. The disadvantaged were identified by pinpointing explanatory factors such as age, gender, disabilities that influenced their travel behaviour, and characteristics such as trip generation, time and distance. Travel behaviour data were found in travel surveys such as the London Area Travel Survey and the Greater Toronto Transportation Tomorrow Survey. The more detailed the travel data collected, such as trip itinerary and geo-coded locations, the more insights could be gained from analysis.

Affordability measurement was usually presented as a budget share of transport-related expenditures. Measurements were often achieved at the city or national level. Carruthers, Dick, and Saurkar (2005) used simple calculation as the number of trips multiplied by the average cost per trip divided by per capita income to create an affordability index for 27 cities in developing countries including Bangkok, Thailand. Gandelman, Serebrisky, and Suárez-Alemán (2019) further considered the expenditure elasticity of spending on transport using Engel curves and found diversified problems between the middle class who were increasingly becoming more car-dependent and the low-income who often relied on public transport.

Exposure to externalities was rarely considered as a form of transport poverty by studies in the field of transport policy. However, the indicators were usually in forms of the level of air particulates, gases or proximity to traffic such as those of the US Environmental Protection Agency (2019).

The importance of composite measures for transport poverty were highlighted by many studies, but very few empirical studies existed. Advantages of such measure are ability to capture multidimensional aspects of a complex concept, simplicity and inclusiveness, which allow policymakers and the public to easily understand and interpret the results without neglecting any latent information (OECD - European Union & Joint Research Centre - European Commission, 2008). A measure developed by Sustrans (2016) can be considered as a type of composite measure although it was simple and did not fully incorporate all aspects of transport poverty. The study used data on car ownership, public transport accessibility and household income to calculate a transport poverty risk score for small data zones throughout Scotland.

Data used by these studies can be categorized into seven types. Population and household basic characteristics such as age, gender, education, and disabilities are typically integrated in all data sources. Income and expenditure used in affordability measurement and determination of households’ or an areas’ socio-economic status are usually obtained from national surveys on household income and expenditure. Labour force data including number or type of jobs, job locations, and unemployment are usually gained from the national labour force survey, but sometimes are integrated in a population and housing census. Travel behaviour data such as trip generation, distance and time are found almost exclusively in dedicated travel surveys conducted at the city or national scale. Public transport network, fares and timetables are available from public transport operators and sometimes in online open sources like OpenStreetMap. Transport-related externalities such as particulates, gases and traffic data are available from government agencies related to environmental protection. Other data
such as personal opinions or reasons which are not included in official data are sometimes collected by the researchers themselves using a small-scale survey.

| Source | Location | Sub-type of Transport Poverty | Dependent Variable | Independent Variables | Sources of Data |
|--------|----------|-------------------------------|-------------------|-----------------------|----------------|
| Sustrans (2016) | Scotland | composite measure | risk score of transport poverty | income, car availability, accessibility to services by public transport | Scottish Index of Deprivation (SIMD), Scotland’s Census Transport Scotland |
| Allen and Farber (2019) | Canada | accessibility | mean access to jobs | number of jobs in the area, size of labour force in the area, travel time by transit driving, unemployment rate, income measures population in the lowest quantiles of transit access and income | Canada Census, OpenStreetMap, General Transit Feed Specification |
| Pojani, Boussauw, and Pojani (2017) | Albania | accessibility | various related to job access | individual attributes, travel behaviour | face-to-face interview |
| Delmelle and Casas (2012) | Cali, Colombia | accessibility | access to BRT bus system and activities around the city | number of populations covered within different walking time bands from services | Metro Cali municipal government |
| Jaramillo, Lizárraga, and Grindlay (2012) | Cali, Colombia | accessibility | disparities between social exclusion and transport provisions | transport social needs, transport provisions | DANE, Metro Cali municipal government |
| Carruthers, Dick, and Saurkar (2005) | cities in developing countries | affordability | share of transport expenditure | number of trips average cost per trip per capita income | The Millennium Cities Database for Sustainable Transport (MCD) |
| Gandelman, Serebrisky, and Suárez-Alemán (2019) | countries in Latin America and the Caribbean | affordability | share of transport expenditure expenditure elasticity of transport spending | household expenditure, household size, household socio-demographic characteristics | income and expenditure surveys of each country |
| Schnücker et al. (2005) | London, UK | mobility | trip-making characteristics (frequency, time and distance) | various individual and household attributes | London Area Travel Survey |
| McQuaid and Chen (2012) | UK | mobility | commuting time | various individual and household attributes | ONS UK Labour Force Survey (LFS) |
5. CASE STUDY: THAILAND

5.1 Context

This section provides some background information and historical data which might indicate the transport poverty situation in Thailand. At the national level, it is difficult to understand transport poverty issues in Thailand due to limited research and data. National household socio-economic survey 2018 data shows that households in Thailand spent 17.7% of their expenditure on transport. This is higher than the 10% threshold used by the RAC Foundation (2012), implying that affordability poverty might be an issue in Thailand. On the other hand, mobility, accessibility and exposure to externalities are still obscure. As public transport including buses and trains only exists in Bangkok and a few large- or medium-sized provinces, this suggests that a large population in the country are lacking access to public transport and must rely on private vehicles like cars and motorcycles, which might cause affordability issues.

Thailand’s 20-year transport system development strategic plan (2017-2036) Ministry of Transport (2016) recognizes high public transport pricing and low coverage of public transport network as two of the country’s weaknesses. Goals of the plan are to promote efficient, inclusive, green and safe transport in the country. The focus of the plan is transport infrastructure and an integrated transport system. 97% of the total budget for the first five years of the plan (2,700 billion THB) will be invested in the infrastructure pillar, which is one among five key strategies of the plan. Key indicators of the plan to ensure inclusive transport are the percentage of public transport users in Bangkok Metropolitan Region, the percentage of inter-city public transport users, satisfaction level of public transport users with special needs and percentage of public transport vehicles with support equipment for users with special needs. The latter two indicators are newly proposed indicators which have never been implemented and measured before. This can be considered as a sign that Thailand is moving towards more careful attention to disadvantaged groups.

Bangkok, the capital city of Thailand, and its five adjacent provinces, together called Bangkok Metropolitan Region (BMR) (Bangkok Metropolitan Administration, 2009), hosting over 20% of the total population in Thailand, are often selected as a study area in research related to transport poverty. Bangkok also has its own autonomous administration
body called the Bangkok Metropolitan Administration, which makes data of the region more available.

BMR’s economic growth came at a price of sacrificed urban environment, and inner areas of the city were more focused on by policymakers neglecting the outer areas of the city (Sintusingha, 2006). Private car has been the dominant means of transport in the BMR while the problems of quality and sufficiency of public transport are generally recognized by the government. Urban congestion is another major issue of the BMR, where road capacity cannot anymore accommodate all private vehicles in the city (Suparee, 2015). Hazardous-level air pollution has caused distress and concern among residents of many provinces in Thailand including BMR in recent years.

5.2 Studies on transport poverty measurement in Thailand

As mentioned in the previous section, almost all studies related to transport poverty measurement in Thailand selected BMR as the study area. Mostly, each study only covered one aspect of transport poverty discussed in Section 3. Moreover, most research focused on Bangkok’s public transport systems, especially the urban rail systems. Issues focused on by these studies include accessibility assessment (Prasertsubpakij & Nitivattananon, 2012, 2013), externalities of the urban rail system (Richardson & Jensen, 2008; Malaitham, 2013; Bray & Sayeg, 2002), built environment and pedestrian behaviour at rail transit stations in Bangkok (Townsend & Zacharias, 2010).

Data used in these studies were often gained from self-conducted surveys where the number of samples are very limited, and some studies were also conducted in small selected areas. Bangkok Metro Systems’ accessibility assessment by (Prasertsubpakij & Nitivattananon, 2012) focused on the perceived accessibility level of selected stations using opinion and behavioural data gained from a questionnaire survey with various hypothesized independent variables such as spatial factors, connectivity, temporal factors, comfort and safety. The results show that perception by different groups of the population were influenced by different factors. Ratanawaraha and Chalermpong (2016) studied mobility of the poor using surveys conducted by the researchers to collect data on individual attributes and travel behaviour in low income groups. It was found that low income and low accessibility to public transport are the two major factors that affect travel behaviour of the poor in Bangkok. Despite cheaply priced public buses in Bangkok, without access to public transport, low-income groups are forced to own private vehicles, especially motorcycles, and consequently spend a large percentage of income on the vehicle and fuel.

Choiejit and Teungfung (2005) were able to use compiled statistics of the Household Traveling Survey 1999 conducted in Bangkok by the Department of Traffic and Transportation to study commuting patterns (direction, mode, and time) among households in different income groups. The analysis method used was only descriptive statistics, not a model computed on actual data usually performed by studies on mobility measurement presented in Section 4. This might be probably due to lack of access to survey microdata. It was found that the population with higher education generally have higher income and generate more trips and travel time. The average number of private cars owned by a household is positively linked to income and travel demand.

A study on an affordability index by Carruthers, Dick, and Saurkar (2005) already mentioned in Section 4, also included Bangkok as one of the
selected cities. Results of the study demonstrated that Bangkok was one of the least likely cities to have an affordability poverty problem either for the average population or the 10% poorest of the population among 27 cities in developing countries. However, the study used compiled average income data (for the whole city, and for the poorest 10%) while the quantity of travel was assumed, and fares were calculated based on public bus fares which have been generally low.

5.3 Availability of data

This section presents some potential secondary data sources to be used for city-wide or country-wide measurement of transport poverty in Thailand by researchers or government as shown in Table 2. Similar sources of data were used by recent empirical studies on transport poverty measurement as presented in Section 4. Public transportation data such as street network, services locations, bus/boat stops, train stations, fares and timetable, are not included in this list as their availability statuses are not steady, but they should be obtainable from the OpenStreetMap database and public transportation operators.

Table 2. A list of potential data sources for transport poverty measurement in Thailand

| Type                     | Source                              | Agency                                | Variables                                                   | Disaggregation Level | Availability                  |
|--------------------------|-------------------------------------|---------------------------------------|-------------------------------------------------------------|----------------------|------------------------------|
| Income and expenditure   | Household Socio-Economic Survey     | National Statistical Office           | number of members with income                               | region               | microdata could be requested |
|                          |                                     |                                       | total members expenditures                                  |                      |                              |
|                          |                                     |                                       | incomes                                                     |                      |                              |
|                          |                                     |                                       | head of household attributes                                |                      |                              |
|                          |                                     |                                       | members with specific conditions                            |                      |                              |
|                          |                                     |                                       | debt details                                                |                      |                              |
| Population and household characteristics | Population and Housing Census | National Statistical Office | gender                                                      | district (Amphoe)    | microdata could be requested |
|                          |                                     |                                       | age                                                         |                      |                              |
|                          |                                     |                                       | highest education                                           |                      |                              |
|                          |                                     |                                       | literacy                                                    |                      |                              |
|                          |                                     |                                       | number of children                                          |                      |                              |
|                          |                                     |                                       | marital status                                              |                      |                              |
|                          |                                     |                                       | main job in the past year                                   |                      |                              |
|                          |                                     |                                       | employment status                                           |                      |                              |
|                          |                                     |                                       | type of job                                                 |                      |                              |
|                          |                                     |                                       | place of job (province)                                     |                      |                              |
|                          |                                     |                                       | disability                                                  |                      |                              |
|                          |                                     |                                       | type of household                                           |                      |                              |
|                          |                                     |                                       | type of ownership                                           |                      |                              |
|                          |                                     |                                       | land ownership                                              |                      |                              |
|                          |                                     |                                       | private vehicle ownership and type                           |                      |                              |
| Travel behaviour         | Travel Demand Survey                | Office of Transport and Traffic Policy and Planning | location                                                   | N/A                  | only summary report           |
|                          |                                     |                                       | number of household members                                 |                      | survey only conducted in     |
|                          |                                     |                                       | income                                                      |                      |                              |
|                          |                                     |                                       | private vehicle ownership                                   |                      |                              |


| Labour force | Labour Force Survey | National Statistical Office | marital status | highest education | education field | employment status | occupation | wage | region | microdata could be requested |
|--------------|---------------------|----------------------------|----------------|-------------------|----------------|-------------------|------------|------|--------|----------------------------|
| Transport externalities | air4thai.pcd.go.th | Pollution Control Department | PM 2.5 | PM 10 | O₃ | CO | NO₂ | SO₂ | hourly average by measurement station | public |
| data.go.th | Digital Government Agency | Annual Average Daily Traffic (AADT) | by main road | public |

6. DISCUSSION AND RECOMMENDATION

6.1 On conceptualization

As evident in many studies and pointed out by some of them, consensus on the definition of transport poverty has not yet been reached. This might be caused by several factors. First, transport-related disadvantages are not only studied under the term ‘transport poverty’, but also under many different terms as presented in Section 3 and a broader concept like transport equity. Moreover, the complexity of different individual travel needs and the multidimensional nature of transport poverty are difficult to capture by a simple definition.

The definition by Lucas et al. (2016) seems to sufficiently cover all the facets of transport poverty. It was criticized by some studies such as Crisp, Gore, & Mccarthy, 2017 that it did not incorporate interactions with some mediating factors such as housing and labour markets. For instance, poor people do not simply spend a larger portion of their expenditure on transport just because transport is expensive, but also because they cannot afford housing in an area where transport costs less. In this sense, transport poverty seems to overlook the complex relationships of certain factors that should be analysed and potentially solved by non-transport perspectives and solutions.

However, the concept of transport poverty has its own advantage as it provides a basis to identify groups of people or geographical areas that are
actually in need or might need better attention from the government. Policy interventions would be another area where policymakers need to take into consideration all related factors and stakeholders. Solutions to transport poverty issues sometimes might not be transport-related. For example, accessibility to jobs and services can also be improved by digital technology that enables teleworking and online transactions. This also implies that the issue requires attention from experts and policy practitioners across disciplines and agencies. Some policies can solve many problems at once regardless of the types of problems. For instance, safe, affordable, accessible public transportation provision (Sustainable Development Goal 11 Target 11.2) can potentially solve transport poverty in all aspects at some level. Some problems might require more attention to details on the mechanism of what caused the problem. Nonetheless, transport poverty serves as a good viewpoint in transport policymaking.

6.2 On empirical studies on measurement

In addition to the challenge of conceptual complexity, transport poverty measurement often heavily relies on data availability. This allowed some studies conducted in developed countries like UK and Canada to get more detailed results or deeper insights owing to the existence of more complete data sources. Besides a lack of complete definition, a lack of a single data source or two or more compatible sources that contain a full set of related variables could potentially explain why studies often focused the measurement on only one sub-concept of transport poverty. Even large-scale surveys on transport behaviour almost exclusively done in developed countries are not comprehensive enough to be used as a source for a well-rounded measurement. Important sources of data include national surveys or censuses by the national statistical offices and a large-scale survey related to transport. The rise of online crowd-sourcing databases such as OpenStreetMap are also making more types of analysis possible, especially on accessibility.

Regarding difficulty of measurement, affordability and exposure to externalities, measurements are rather straightforward while mobility and accessibility are more complex in terms of methods used and data needed. Exposure to externalities is somehow isolated from other sub-concepts and was not often considered as a form of transport poverty manifestations. Also, as it might be studied in other fields such as healthcare and environmental studies, it requires further consideration on its relations with other sub-concepts and measurement.

Much research highlights a lack of composite measures for transport poverty. A transport poverty index created by Sustrans (2016) consisted of three sub-measures, but selection criteria was unclear, and the simple arithmetic average was used to normalize all the indicators without stating clear reasons on the equal importance of all three indicators. Also, creating a composite measure would require caution toward the interrelatedness of the sub-concepts, which is most likely happening as a form of area-based measures because of the nature of data.

6.3 On the situation of transport poverty in Thailand

As only a limited amount of research on Thailand was found, transport poverty seemed not to have captured the interest of many researchers or government in Thailand. Government transport plans in Thailand mainly
focus on overall transport provisions rather than the actual needs or necessity of the population, especially of the disadvantaged.

Researchers often choose to focus on the urban rail transit exclusive to the Bangkok Metropolitan Region (BMR). Urban rail systems in Bangkok currently cover only a very limited area of the BMR. The majority of people in the BMR still rely on private car, motorcycle or public bus. The urban rail fares are generally regarded as high considering the average income of people living in the city. The PPP (Purchasing Power Parity)-adjusted average fare per 1 km for the urban rail system in Bangkok is 0.478 USD/km, higher than London, Singapore, or Hong Kong (Thailand Development Research Institute (TDRI), 2019). As the current minimum wage per day in the BMR could be converted to around 10 USD (325 THB), urban rail might not be an ideal option for the poor. Moreover, provinces outside the BMR where limited public transport systems exist, people still rely on private vehicles and are almost completely left out by studies. In this sense, a large proportion of the transport poor in Thailand would be ‘off the radar’ of government policy and researchers’ interests. This was probably due to lack of data sources or the fact that that issue was not given a high priority in Thailand.

6.4 On possibilities for transport poverty measurement in Thailand

The Travel Demand Survey might be Thailand’s only source that contains travel behaviour data essential for mobility measurement. The basic individual and household characteristics data collected by the survey were very limited (the number of members in the household and household income). The data was not publicly available, and the survey was only conducted in eight provinces including the BMR. Due to sample sizes, the survey data also might not be available at small geographical levels. Mapping travel behaviour data against geographical environmental data such as land use, street networks and public transit nodes can be achieved but might not be useful due to a lack of granularity.

Household Socio-Economic Survey microdata would provide sufficient data on variables to conduct affordability measurements such as share of transport expenditure at the provincial level for the whole country. The Travel Demand Survey was another source that contains data on household income and transport expenditure for the BMR. Potentially, combined indicators of mobility and affordability could be created for the BMR at the zone level (with a total of nine zones across the BMR), but the data was not made public.

Accessibility measurement has been recently investigated by studies in Thailand, which have more often focused on public transit, especially urban rail systems in the BMR. Accessibility measurements are becoming more possible in Thailand as geo-coded location data (containing GPS coordinates) are available from open online data sources such as OpenStreetMap. This can make measurement of accessibility to any location (such as services) from any location (such as home) possible with the help of GIS.

There are many types of transport externalities which need to be selected based on the context and priorities of a country. Data on major forms of externalities such as air quality, and traffic proximity and volume, are available on government agency websites making future analyses or index compilation possible with further help from appropriate models.
A composite measure would still be complicated to develop and might not have a great value because of a lack of research that proposes a well-developed guideline to create composite measures, and international comparison may still be non-existent. Also, data availability in Thailand only allows measurement in each sub-concept at a large-area level. Composite measures at this large scale might not have much use in research or policymaking.

It should be noted that most studies, both international and those done in Thailand, almost always exclude the roles of informal modes of transport. In developed countries, they might not exist or have a very subtle role; however, in developing countries like Thailand, they are most likely to play very important roles in the transport sector in terms of mobility, accessibility, affordability and exposure to externalities. They usually exist in locations where formal modes are not available and have their own costs (high fares, externalities) and benefits (on-demand mobility and improved accessibility) (Cervero & Golub, 2007). Failing to incorporate their roles and impacts on transport poverty measurement in Thailand would result in biased and inaccurate outcomes.

### 6.5 Recommendations

The issue of transport poverty needs more attention from researchers and related government agencies in Thailand. The issue is not limited to the field of transport, it is rather a cross-cutting issue and would require collaboration among researchers and practitioners across disciplines and agencies to tackle.

A single source or multiple compatible sources of travel data that contain necessary variables or allows measurement at a small geographical level would be crucial. This is because data from two or more different sources normally cannot be combined due to differences in survey design. In recent studies, measurements could be achieved owing to availability of such data sources. To illustrate, Canada’s population census available at the census dissemination area level with income and job location data was used by Allen and Farber (2019) allowing them to analyse job accessibility and socio-economic status, and map the two variables at the census dissemination area level, while Thailand’s Population and Housing Census data was only available at Amphoe level (third smallest administrative unit), or Tambon level (second smallest administrative unit) from microdata, without income and job location data. However, it would require a lot of resources to conduct such a survey, as well as communication between government agencies.

Lastly, the Ministry of Transport of Thailand should make the Travel Demand Survey data publicly available as it has a high potential as a data source for transport poverty and other types of research in Thailand.

### 7. CONCLUSION

Transport poverty is potentially a valuable concept that focuses on the social justice aspect of transport research and policymaking. Conceptualization and measurement of the transport poverty issue has not been well-developed compared to some other similar concepts in transport. The issue however appears to be gaining more attention from researchers, but is far from being properly put into practice. Being complex and data-demanding in nature, transport poverty measurement often has had to deal
with limitations, especially in developing countries where data is usually not abundant. The issue has not gained much attention both from researchers and government agencies in Thailand. Data available in Thailand are suitable for specific analyses to some extent but more complete data sources are needed. To efficiently tackle the issue in terms of assessment and finding solutions, expertise and cooperation from researchers or policy practitioners outside the field of transport are also likely required.

This paper only focuses on studies related to the term ‘transport poverty’. There are potentially other concepts that focus on social disadvantages of transport such as transport equity. Assessment of data availability in Thailand in this study was done using official websites and online channels as the sources, therefore, some important existing sources of data not available online might have been missed. This study does not include the possibility of applying statistical techniques such as Small Area Estimation (SAE) which enables estimation of small geographical area statistics and might allow specific types of measurements not acknowledged by this study.

It is apparent from the results of this study that some types of measurements such as the household transport affordability index at the provincial level and multiple public transport modes’ accessibility measurement at small-area levels in the BMR could be performed immediately in Thailand. As a fine-scale multidimensional measurement of transport poverty, in Thailand it is most likely hindered by the lack of a comprehensive data source, future studies on transport poverty measurement in Thailand and developing countries should also explore and consider non-traditional data sources such as mobile positioning data, social media, satellite imagery and others as an alternative source to the existing national surveys and censuses which might not be suitable for a study that aims for results at finer levels.

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