EQUITY IN URBAN TRANSPORT

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ABSTRACT

Urban transport policies have not traditionally considered equity or fairness of the outcomes in the transport policy and projects design. Since India is undergoing rapid urbanization with increasing inequality, the recent push towards sustainable transport demands a need to consider fairness to all groups of population with varying capacity and needs. The paper has studied available literature on sustainability and equity assessment methods with an understanding of the Indian policymaking context to develop a theoretical framework that can assess equity in transport policies. For this purpose, authors have studied existing methodologies of assessing economic, environmental and social dimensions of transport sustainability in international cases. The study has developed a theoretical framework for equity assessment of policies in India through aggregate indicators and context-specific variables. The study has also identified the major challenges and research gaps.

Keywords: Equity, urban transport, sustainable, assessment framework.

1. INTRODUCTION

Equity, in general, is the fairness or justice in the distribution of public goods without discrimination of income, age, ethnicity, ability, gender and geography. Transportation policies can have diverse impacts on various groups affecting their economic and social opportunities, accessibility, expenditure on the commute, taxation and economic development. Transport equity assessment is difficult considering the numerous types of equity and impacts that different stakeholder groups can perceive differently.

Sustainable mobility is aimed to ensure a transportation system that fulfils the economic, social and environmental needs of the society while reducing externalities (Council of European Union, 2006). Alternate fuel usage (electric vehicles, hydrogen fuel cells, Compressed Natural Gas, Biodiesel) and rapid public transit systems (BRTS, Metro rail, LRT, Trams), active transport modes (pedestrian, cycling) and policies to shift car users to shared mobility are generally considered sustainable transport. Although sustainable transport has gained traction in the research and practice sphere, there is little consensus on what must be sustained and how this is to be done (Mahadevia, 2001).

Transport equity has historically been neglected as an objective of the investigation by sustainable transportation researchers and planners. This situation is highlighted in developing economies where the financial and resource deficit to maintain, upgrade or install a public transport system is an issue. Until recently, most city-level transport policies focused on motorization and neglected NMT and public transport systems. Transport

policies implemented in India has not included equity in its planning framework to date. Although United Nations SDG 11.2 pushes for access to safe, affordable, accessible and sustainable transport systems with particular attention to vulnerable groups such as women, children, disabled and older persons, it has not materialized in practice to full extent. For example, public transport accessibility distribution is skewed geographically in urban areas, with specific regions receiving more infrastructure provision and some locations without even basic infrastructure. Zoning in urban areas has distorted the land prices leading to high land costs and subsequent displacement of low-income group, who primarily uses public transport having to spend more of their income on commuting to work (Pereira, Banister, Schwanen, & Wessel, 2019), (Dixit & Sivakumar, 2020).

2. OBJECTIVES

The paper has the three objectives as follows:

i) To review existing literature on urban transport equity assessment methods.
ii) To identify the research gaps in existing assessment frameworks and methodologies.
iii) To propose a suitable transport equity assessment framework for the Indian context.

3. POLICY PROBLEM

Urban transport policies outcomes are inequitably distributed among the public in India due to planning and implementing issues. The increased number of vehicles and unsustainable haphazard growth of cities has led to an increase in traffic congestion, poor public transport, high levels of emissions and poor quality of life. The new decarbonization agenda with low emission mobility needs consideration of affordability, access and justice. Current standard methods of assessing the sustainability of urban transport, which is considered a benchmark for urban transport, have numerous limitations with regard to equity consideration.

4. LITERATURE STUDY

4.1 Theoretical Overview

4.1.1 Equity in Transport

Equity is defined as the fairness with which the impacts (benefits and costs) are distributed among the population. Transportation policy can impact the economic and social opportunity of the population through external costs, household expenditure share, public resource allocation, accessibility, land prices and economic activities. Therefore, it is important to assess the equity of urban transport policies. Even if the policymakers wish to include equity in the planning process, the lack of comprehensive guidance to analyze transport equity prevents it (Litman, 2002). There is a conceptual ambiguity regarding equity and it is difficult to compare findings, mainly due to the perspective influence. A policy intervention that may seem equitable through a particular set of indicators might not be equitable from another perspective.

Transportation equity is categorized into three; horizontal equity, vertical equity with respect to income and social class, vertical equity with regard to mobility need and ability (Litman, 2002):

i) Horizontal equity, also called fairness and egalitarianism, is where everyone is treated equally irrespective of ethnicity, gender, or income. Accordingly, the

distribution of resources, benefits and costs will be equal to all groups. This indicates that public policies should refrain from favouring any particular groups, and consumers get what they pay for and pay for what they get.

ii) Vertical equity with regard to income and social class considers the distribution of benefits and costs according to their social and economic class (social justice, environmental justice, social inclusion). According to this Rawlsian idea, policy should support disadvantaged groups to compensate for the inequities (Rawls, 1971). Affordability, special concessions and services are considered so that the disadvantaged groups do not bear excessive costs (pollution, health, financial).

iii) Vertical equity with regard to mobility need and ability acknowledges that the different groups require varied mobility and ability to move. Universal design and accessibility, which considers mobility impairment stems from the consideration of this type of equity.

Transport equity consideration can have the following broad categorical impacts: Public facilities and services (funding, subsidies, planning and design), costs and benefits (fare level of mobility and accessibility, operating charges of vehicles, public transport), service quality (mode choices, infrastructure quality), externalities (congestion, pollution, liveability), economic impacts, (access to opportunities of education, employment), regulation and enforcement (Public transport formalization, sensitivity).

The existing equity analysis is mostly ad hoc and focuses on a narrow set of indicators. Some significant impacts and participatory planning processes are overlooked in most cases. However, recently there has been an increased number of studies asking the following questions concerning justice and equity in transportation.

- Which areas benefit from infrastructure projects in a city? (Currie, 2010) (Foth, 2013).
- How does transport policy impact different income classes with regards to affordability? (Levinson, 2010) (Pucher, 1981).
- Which groups of population are more at risk and exposed to externalities like pollution and accidents? (Feitelson, 2002) (Forkenbrock, 1999).

Studies indicate that low-income groups who depend on public transport get impacted the most by the increased land prices and displacement, as seen in the case of displacement after the implementation of Ahmedabad BRTS (Mahadevia, Joshi, & Datey, 2013), where they are forced to rely on personal vehicles making trips that are costlier and longer. In some cases, public transport passes require a high upfront cost which the low-income group cannot afford, and this results in the purchase of short term tickets, which increase the cost by up to three times (Nuworsoo, Golub, & Deakin, 2009). The high-income group on the other hand are more mobile and contributes to more congestion and emissions, and still it is the low income group who bears the cost (Titheridge, Mackett, Christie & Hernandez, 2014) (Huang & Onstein, 2020).

Taxing people based on the emission rates have been proved ineffective as it can affect the low income group since they mostly possess more polluting vehicles compared to high income group. (Bento, Goulder, Henry, Jacobsen & von Haefen, 2005). High occupancy toll (HOT) is another intervention that has been viewed has a progressive measure to reduce congestion on roads (Altshuler, 2013), but it poses barriers to affordability depending on transit provision (Schweitzer, 2009).

4.1.2 Mobility Justice

The idea of justice in mobility has gained traction in recent academic literature, but there is a lack of consensus regarding methodology and approach. The broad three dimensions of just-mobility are; *Distributional justice*, which considers the distribution of benefits (resources, opportunities) and costs (fare, pollution); *Procedural justice*, which considers inclusiveness in policymaking and governance; *Justice as recognition* of the rights, needs, values and culture of groups affected. With the ongoing transition to low-carbon mobility by reducing GHG emissions, justice is not given priority in the performance assessment. For example, the Electric vehicle subsidies are such that the beneficiaries are high-income group whereas mass transit such as BRTS benefit the poor and middle-income group (Venter, Jennings, Hidalgo, & Pineda, 2017), (Mahadevia, Joshi, & Datey, 2013).

4.1.3 Accessibility

Accessibility is the measure of being able to access potential opportunities. In transportation, access is the goal for most activities but there is a tendency to assess the level of service of transport by measuring mobility and not accessibility. (Geurs & van Wee, 2004) distinguished four types of accessibility measures:

i) Infrastructure based (existing, supply based method of SDG 11.2).
ii) Location based (land use and transport integration at macro scale).
iii) Person based (considering individual level constraints, time, activity location), this method cannot be applied to the whole population.
iv) Utility based (economic benefits for people to reach spatially dispersed activities). This measures if the intervention of the policy has provided more utility.

Accessibility based planning is important for social equity as it considers location and their ability to access basic services and opportunities.

4.2 Evaluation Methods of Urban Transport Sustainability

4.2.1 UN – SDG Assessment

The accepted indicator for SDG 11.2 is based on '*the proportion of population that has convenient access to public transport by sex, age, and person with disabilities'* (*access to a public transport stop at least 500m or 5 minutes walking distan*ce). This indicator is supply-oriented and focuses on provision and not accessibly of infrastructure. Although it gives an idea regarding the transport system, it does not address the people's usage details of the infrastructure by looking at affordability, quality, and reliability. It does not consider informal public transport, which is a major mode in smaller cities in India. The ineffectiveness of the indicator is evident in the case of Bogota City, which has the most successful BRT project globally, but the inequality stayed high.

4.2.2 Lyon Study

(Nicolas, Pocheta, & Poimboeuf (2003) defined indicators for urban transport sustainability assessment at Lyon, France. The indicators covered all three dimensions of sustainability: environmental, social and economic and are descriptive in nature. The study has also combined multiple indicators from different dimensions, such as the spatial distribution of emissions. Also, the space occupancy in public transport is measured in m^2hours. The study has considered three dimensions separately and suggests a *Paretian* approach that is if increased sustainability would improve any one dimension without reducing another.

4.2.3 Sustainable Transport Index USA

In a study, (Black, 2000) in the USA, where the key threats to sustainable transport were identified (fuel scarcity, emission impacting local air quality, GHG emission, accidents and congestion) and integrated into sustainability indicators. The economic and environmental dimensions are considered but social equity is excluded. The indicators are descriptive and directly drawn from available statistical data. The principal component analysis is used to form an aggregate index of sustainability. The absolute value of data resulted in strong variation among the states; large states performed poorly compared to smaller states.

4.2.4 TERM European Union

The Transport and Environment Reporting Mechanism (TERM) is a monitoring framework with 35-40 indicators to support political procedures ensuring integration of environmental issues into transport policy. Although it is not designed to assess sustainability, it covers environmental issues and some economic factors. Most of the indicators are descriptive but also with policy effectiveness and eco-efficiency indicators. Indicators are not quantitative and are rather simplified. Although it is not conclusive regarding the sustainability of the policies, the favorability of policy direction can be understood by a smiley symbol against each indicator (Gudmundsson, 2004).

4.2.5 Transport Canada

Sustainable Development Strategy (1997) is a mandatory program by the ministry of transport, Canada with over seven challenges (awareness of sustainable transport, tools for decision making, adoption of technology, improving environmental management, air emission, water pollution, efficient transportation), 29 commitments and 80 targets and performance indicators. Its focus is on the environmental dimension in institutional and policy aspects. Performance is measured against qualitative policy commitments, which is useful in checking the efforts towards political commitments. (Gudmundsson, 2004).

4.2.6 ITDP Study USA

The Institute for Transport and Development Policy study (Chestnut & Mason, 2019) on 25 cities identified 12 indicators based on proximity to transit, access to opportunity and city characteristics. The proximity to transit is measured as people/jobs/low-income households near rapid transit (within 500m or 10 min walk). The study has distinguished between rapid transit and near-frequent transit. The access to opportunity considers access to jobs, low skill jobs, by sustainable transit that can be reached within 60 and 30 minutes within census tracts (census districts). The city-characteristics consideration includes block density (average number of blocks per sq. km) and weighted population density. However, it does not take into account the quality and usage of the infrastructure.

4.2.7 Comparison and Conclusion

The case studies have shown that indicators' function will depend on the respective context and serve different stakeholders with varying priorities. However, the contribution of the transport system towards the deterioration of urban air quality, climate change, depletion of fossil fuel and accidents are the recurring themes. Some socioeconomic indicators such as transportation costs, congestion and accessibility are included. Institutional dimension is included in some cases, but the extent of causality is not clearly defined. The measurement of sustainability from the aggregation of the indicators show a varying trend among the studies. The selection of indicator heavily impact the outcome of the analysis; if a policy is not sustainable considering GHG emissions, it might be sustainable considering economic opportunities. Indicators cannot provide conclusive answers to complex transport problems; they can merely ‘*indicate’* the direction of the policy.

Table 1: Comparison of sustainable transport assessment methods

	Lyon study	USA	EU -TERM	Canada	ITDP USA
Dimensions	Econ, Env, Social, Mobility	Econ, Env, Transport	Econ, Env	Econ, Env, Institution	Econ, Social
Main focus	Analytical info to policymakers	facilitate inclusion of sustainability concerns in transport analysis	Monitor developments of policy interventions	Environment, institution	Proximity, access, city characteristics
Indicator type	Descriptive, not performance-based	Descriptive, Qualitative	Descriptive, No quantitative	Qualitative performance	Quantitative
Indicator remarks	m^2h for measuring space occupancy in PT, spatial distribution of emission	14 indicators, monitor	30-40 indicators Favourability of policy decision, monitor	80 targets and performance indicators, Government accountability	12 indicators
Uniqueness	Considered 3 dimensions separately	Absolute value	Smiley symbol	education and awareness of sustainable transport	25 cities applied
Approach/ Methods	Paretian approach to dimensions	principal component analysis - derive index of sustainability	Overall negative or positive towards commitment	Cross check policy commitments	Arc GIS network analyst
Drawbacks	Not performance based so open interpretation	Strong variation with size of states, no social dimension	assessment, monitoring not linked to control system Does not provide criteria for sustainable transport	System level implications are unclear	Depends heavily on opensource data accuracy, living costs not considered, urban design

4.3 Equity Evaluation Methods

4.3.1 Comprehensive Equity Analysis Criteria and Indicators

Social equity analysis of urban transportation has various scope and methodologies depending on the preference and perspective (Weisbrod, 2001). A better conceptual understanding of equity and consistent evaluation methods are necessary to ensure equitable transport policy. Litman (2002) identified five main indicators to assess transport equity, namely:

Table 2: Equity indicators

Criteria	Comments
Horizontal equity	Are comparable groups treated equally?
Cost-based pricing	Does the user bear their own costs?
Progressive with respect to income	Does the policy benefit or harm lower-income groups?
Benefits transportation disadvantaged	Does the policy benefit or harm transport of disadvantaged (with disabilities, low-income)?
Improve basic mobility	Does the policy favor important transport (emergency, commuting, shopping) over less important ones?

Source: (Litman, 2002)

Although equitable transportation traditionally comes with tradeoffs, an integrated planning approach that consider a wider range of impacts and choices can identify and implement win-win solutions that ensure economic, social and environmental aims (Litman, 2008).

4.3.2 Litman (2021)

Litman (Litman, 2021) has comprehensively summarized key variables, metrics and target groups in transport equity analysis. Consideration of different perspectives, impacts and methods are necessary to evaluate transport equity. Although there is no definitive proof that the selected variables can evaluate equity accurately, it comes close, as it considers different perspectives and impacts majorly observed in urban transport issues. The selection of variables can alter the outcome of the assessment of equity. Therefore it is important to select the appropriate indicator for the context. Litman has demonstrated the impacts, metrics, and groups for the different types of equity in the study. The types of equity are categorized as Horizontal, vertical (ability), Vertical (income) and social justice. The impacts are on facilities and services, cost-benefit, quality of service, externalities and enforcement. The main metrics used are the level of impacts (funding, cost, safety), units of people, travel units, and financial (per unit subsidy). The groups are divided as per demographics, location, industries and trip types.

Table 3: Equity evaluation framework

Types of Equity	Impacts	Metrics	Groups
Horizontal (Fairness) Equal benefits and costs **Vertical with-respect-to need and ability** Multimodal planning Universal design Special mobility services **Vertical with-respect-to income and social class** Affordability Quality of low-cost modes subsidies Impacts on low-income Communities **Social Justice** Impacts on minority communities Affirmative action	**Facilities and Services** Facility planning and design Funding and subsidies. inclusive planning **User costs and benefit** – tax, fee, fares **Service quality** (convenience, comfort, speed, safety). User information **External Impacts** Congestion, accidents Pollution **Economic Impacts** Job and business **Regulation and Enforcement**	**Level of Impacts** Inputs (funding, road space, etc.) Outputs (amount of mobility and accessibility) Outcomes (trips made, cost burdens, crash injuries) **Units of People** Per adult Per commuter or peak period travel Per household **Units of travel** Per vehicle - km Per passenger - km Per trip (by type) **Financial** Per Dollar Subsidies Cost recovery	**Demographics** Age ,sex, (Dis)ability Income Ethnicity **Location** Jurisdiction and neighborhood Urban/suburban/rural **Mode** Active (walking & bicycling) Motor vehicles. Transit **Industries** Freight Public transport, Auto and fuel industry **Trip type** Commute Commercial emergency Recreational.

Source: (Litman, 2021)

4.4 Impact of Policy on Equity: Cases

4.4.1 Bogota City BRTS (Pro Poor Subsidy)

Cities in developing countries face a high level of income inequality which translates to accessibility to access opportunities and transport affordability. The research by (Guzman & Oviedo, 2018) compared the accessibility change between 2011 and 2015 in the city of *Bogotá* and *Soacha* and determine if the pro-poor subsidies in the public transport sector influenced the accessibility levels of low-income group. They have incorporated transport and land use with assumptions on travel cost by using the exponential decay function. The study measured potential accessibility, affordability and equity. They have used the Gini coefficient and Pseudo-Palma ratio to understand the moral dimension of inequality distinguishing the winner and losers. The study showed that the efforts of the city towards equity has positive outcomes and highlight the importance of targeted social policy in the transport sector to reduce inequalities in distributional impacts.

4.4.2 Beijing – Relative Accessibility in Megacity

In a study by (Sun & Zacharias, 2020) the policies to limit car usage and encourage public transport in Beijing were examined from a transport equity perspective by measuring accessibility disparity among car users and public transport users. The study has used the accessibility equity index considering the spatial distribution of population and employment using GIS. Different scenarios were taken considering varying travel budgets and AEI (Accessibility Equity Index). The rapidly developing suburban areas with the gradual build-up of public transport and road network have increased the demand for private vehicles. The government has reduced the number of cars purchased by limiting the number of license plate registration. However, it has not resulted in better accessibility. The authors conclude that adjusting land use is a more efficient method to reduce car dependency.

4.4.3 Free Public Transport Luxembourg

The government of Luxembourg, aiming to prioritize the environment and end traffic congestion, made all public transport, including buses, trains, trams, free from March 2020, with the concept of Free Fare Public Transport (FFPT). The policy was deemed feasible since fare collection accounted for only 8 per cent of the operating cost (UITP, 2020). But there are arguments that free transit may generate useless mobility, increasing emission levels from public transport and tax burden. Only cyclists and pedestrians tend to shift more than car users to the free transit. The mode share of transit increased, with the congestion level impacts minimal in some studies (Kębłowski, 2019). Such policy needs to be accompanied by measures to curb parking, congestion charging and increased fuel tax to reduce private vehicle usage more effectively. It is considered a progressive social policy that can contribute to equity by guaranteeing access to all groups, especially in cities of developing countries.

4.4.4 Delhi Metro Fare Hike

In 2017-10, Delhi Metro Rail Corporation increased its fare twice in a row by citing an increase in operational expenditure. This subsequently resulted in a decline of ridership by 15 per cent (0.3 million) within three months. Globally 10 per cent of household income of the poorest 20 per cent of the population is considered as affordable for the transportation system. In Delhi, even with a 15 per cent cap, more than 34 per cent of the population will not be able to afford a basic non-ac bus. The poor population has to spend over 22 per cent of their daily income travelling the Delhi metro, thereby pushing them into more poverty (Centre for Science and Environment, 2019). In comparison, Singapore transport has around 3-4 per cent cost of the daily income of last 20 per cent of the poor population.

4.5 Indian Urban Transport Policy Scenario

4.5.1 Current Transport Equity Scenario

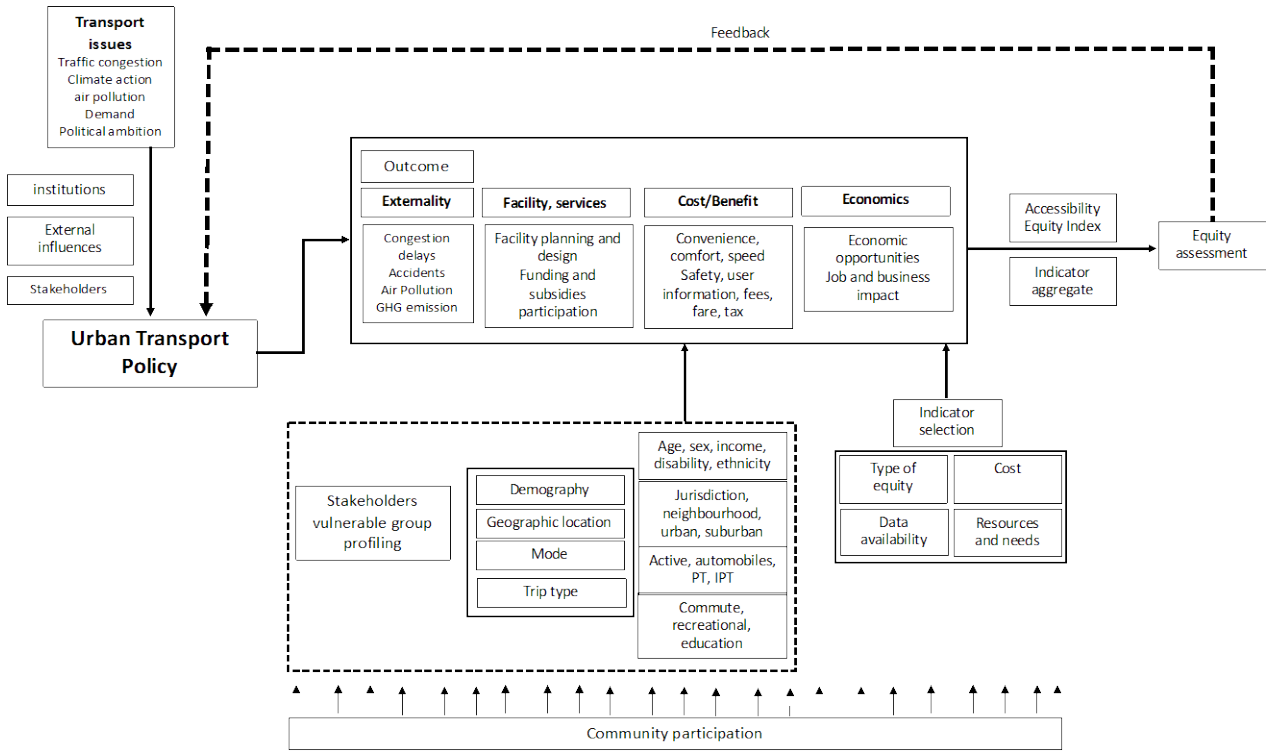
The increasing urbanization has posed severe challenges to cities' infrastructure capacities and quality of life. Road congestion, parking deficiency, air pollution (local and global), reduced safety are some of the main issues policymakers have to tackle. A lack of legislation that comprehensively covers urban transport at the Central, State and Local government level, along with fragmented institutional framework with overlapping and non-definitive responsibility distribution, is a prevailing wicked problem. The institutional *'tetris'* in infrastructure regulation is a major challenge that requires integration of governance, regulation and policymaking of urban transport.

With over a quarter of the population under the poverty line, the unaffordability of public transport and a lack of public transit choices have increased stress on vulnerable groups. The household income is still the single largest determinant for the amount of transport, even with the high density of Indian cities (Ahmad & Oliveira, 2016). With the recent focus on sustainable mobility and green mobility in policies such as electric mobility, modernization of transport fleet and other measures, equity consideration has become limited in the planning process. The public transport sector is also deteriorating with a high deficit in the fleet and level of service. The smaller cities are financially inefficient compared to metropolitan cities, and some does not have formal public transport and rely on shared vehicles. Although NMT (Non-Motorized Transport) modes are important for environmental, economic and social benefits (Verma & Rahul, 2014), they are hardly on the government agenda. Some cities (Kolkata) have even banned the use of bicycles in certain areas, to give more space to motorized modes (Press Trust of India, 2014).

Stakeholder perspective plurality in planning and decision-making has led to a lack of consensus regarding moral accessibility criteria selection which highlighted the conceptual and practical ambiguity regarding equity in urban transport. Increasingly neoliberal policies may favour the egalitarian concept where the "*pay for what you get and get for what you pay"* could be idealized over the Rawlsian idea of supporting the ones who need the most help. The trade-offs among equity objectives and other planning objectives such as mobility over accessibility is another challenge. For example, a subsidized bus fare may increase the tax burden on non-bus users. Since the weight distribution for each indicator is not predefined, the overall output must reflect the needs of the people without affecting the needs and access of others.

5. TRANSPORT EQUITY ASSESSMENT FRAMEWORK

The framework shows a comprehensive methodology to assess equity in a transport policy. It begins by tracing the policy origin, understanding the causalities and drivers involved. The stakeholders and policymakers also are important to be identified. The outcomes of the policy have to be looked at from vulnerable stakeholder groups' perspectives. The vulnerable groups must be identified according to demography, geographic location, transport mode and trip characteristics criteria. From the vulnerable groups, the indicator selection should be carried out appropriately considering the impact and the available resources and need along with the type of equity. The impact of the policy is broadly classified as facility provisions, cost-benefits, economics and externalities. An accessibility equity index can be developed along with other aggregate indicators to assess the equity of the policy impact. The results can be given as feedback to the policymaking process to improve and correct the direction if necessary.



Source: Author

Figure 1: Proposed transport equity assessment framework

6. RESEARCH GAPS

The major research gaps identified in equity assessment of urban transport are:

- The transport equity indicator selection process has not been deliberated in literature.
- Conveyance modes to policymakers using simple-to-use suggestive indicators and assessment methods are not explored to their full potential.
- Consideration of stakeholders is minimal in existing procedures of assessment, and the focus is on impacts.
- A generalizable indicator and framework including equity in the sustainability of transport assessment are not available.
- Lack of consensus regarding the definition of sustainability, equity, vulnerable groups
- The stakeholder (individual) perspective regarding fairness has not been considered.
- Although the literature suggests harmonising governance and urban transport policymaking, the extent and scope are not clearly defined.
- Welfare consequences need to be included.
- Inadequacy of supply is rarely research agenda while considering inequality issues.
- Integrated GIS and spatial multi-criteria analysis to evaluate spatial equity are rare.

7. CONCLUSION

Specific emphasis should be given to planning and designing integrated policies to improve the transport sector's social, environmental, and economic performance without compromising on other dimensions. There is a need to have a bridging of the abstract concept of sustainability and equity into practical application through a robust framework. Stakeholder identification needs to be done by defining the vulnerability and the intensity along with the groups. Indicators can decide the level of problem definition and impact

identification. Therefore it is critical to select the right indicators by considering data availability, cost and usefulness in the decision-making process. An indicator that focuses on just one dimension may negatively impact the outcomes of the policy. Equity goals need to be defined clearly to incorporate the same into the planning process.

Current policies tend to favour automobile travel over affordable modes, increasing the inequality in society. Shifting from a mobility-based approach to an accessibility based approach can have equity benefits considering geographic location and affordability. Urban mobility has multi-centric policymaking and implementation process. Therefore it is important to have coherent linkages among stakeholders and policymakers to ensure equity considerations from the deliberation stage to the operational stage. A lack of performance monitoring mechanism in the policy implementation is another issue that influences the policy's outcomes.

Transport equity can be difficult to analyze considering different types of equity, issues, methodologies and categories of people. A consensus on a definition of a vulnerable population is required to effectively identify the groups and ensure participation in the policymaking process. The per-capita performance of outcome should be preferred over absolute numbers, which can skew the results, as seen in the case of the USA study. A decision-making framework with an evidence-based understanding of the impacts and benefits of various population groups can ensure better equity assessment. There is a need to move forward from 'negative/positive' impact to a more nuanced understanding of the impact intensity and capability of the vulnerable groups in macro and micro levels.

8. REFERENCES

Ahmad, S & Oliveira, JP, 2016. Determinants of urban mobility in India: Lessons for promoting sustainable and inclusive urban transportation in developing countries. *Transport Policy,* 50:106-114.

Altshuler, A, 2013. Equity as a Factor in Surface Transportation Politics, 42:2-9. Available at: https://escholarship.org/uc/item/7pd4c1jj.

Bento, A, Goulder, L, Henry, E, Jacobsen, M & von Haefen, R, 2005. Distributional and Efficiency Impacts of Gasoline Taxes: An Econometrically Based Multi-Market Study. *American Economic Review,* 95(2):282-287. doi: 10.1257/000282805774670536.

Bills, T & Walker, J, 2017. Looking beyond the mean for equity analysis: Examining distributional impacts of transportation improvements. *Transport Policy,* 54:61-69. Available at: https://doi.org/10.1016/j.tranpol.2016.08.003.

Black, WR, 2000. *Toward a Measure of Transport Sustainability.* Washington, D.C: Transportation Research Board.

Boarnet, M, 1997. New highways & economic productivity: Interpreting recent evidence. *Journal of Planning Literature,* 11(4):476-486.

Centre for Science and Environment, 2019. *The cost of urban commute: Balancing affordability and sustainability of public transport.* New Delhi.

Chakwizira, J & Mashiri, M, 2009. Contribution of transport governance to socio-economic development in South Africa. Southern African Transport Conference.

Chestnut, J & Mason, J, 2019. *Indicators for Sustainable Mobility.* New York: Institute for Transportation and Development Policy .

Cohen, S & Cabanasagan, C. 2017. *A framework for equity in new mobility.* Oakland, CA: TransForm.

Council of European Union, 2006. *Review of the EU Sustainable Development Strategy (EU SDS) – Renewed Strategy. 10917/06.* Brussels, Belgium.

Currie, G, 2010. Quantifying spatial gaps in public transport supply based on social needs. *Journal of Transport Geography,* 18(1):31-41.

Daniel Carlson, ZH, 2010. *Impacts of VMT Reduction Strategies on Selected Areas and Groups.* Washington State Department of Transportation.

Department of Heavy Industry & Public Enterprises, 2019. *Press Information Bureau*. Available at: https://pib.gov.in/PressReleseDetailm.aspx?PRID=1597099

Dhar, S, Pathak, M, Shukla, P & Gupta, A, 2020. Electric vehicles penetration in India for enhanced energy efficiency deployment in the transport sector.

Dixit, M & Sivakumar, A, 2020. Capturing the impact of individual characteristics on transport accessibility and equity analysis. *Transp Res Part D: Transp Environ,* 87(10243).

Feitelson, E, 2002. Introducing environmental equity dimensions into the sustainable transport discourse: Issues and pitfalls. *Transportation Research Part D: Transport and Environment,* 7(2):99-118.

Forkenbrock, DJ, 1999. Environmental justice in transportation planning. *Journal of the American Planning Association,* 65(1):96-111.

Foth, N, Manaugh, K & El-Geneidy, AM, 2013. Towards equitable transit: Examining transit accessibility and social need in Toronto, Canada, 1996-2006. *Journal of Transport Geography,* 29(1):1-10.

Geurs, K & van Wee, B, 2004. Accessibility Evaluation of Land-Use and Transport Strategies: Review and Research Directions. *J. Transp. Geogr,* 12:127-140. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0966692303000607?via%3Dihub.

Gudmundsson, H, 2004. Sustainable Transport and Performance Indicators. *Issues in Environmental Science and Technology,* 20:35-63.

Guzman, LA & Oviedo, D, 2018. Accessibility, affordability and equity: Assessing 'pro-poor' public transport subsidies in Bogotá. *Transport policy,* 68(30):37-51. Available at: https://doi.org/10.1016/j.tranpol.2018.04.012.

Helling, A, 1997. Transportation and economic development: A review. *Public Works Management & Policy,* 30(1):79-93.

Huang, LY & Onstein, E, 2020. How do age structure and urban form infuence household CO2 emissions in road transport? Evidence from municipalities in Norway in 2009, 2011 and 2013. *J Clean Prod,* 265(121771).

Johnston, RA & Gao, S, 2009. *Public Versus Private Mobility for the Poor: Transit Improvements Versus Increased Car Ownership in the Sacramento Region.* San Jose, CA: Mineta Transport Institute.

Kębłowski, W, 2019. *Fare-free public transport: critical lessons from multiple sites.* Brussels: Innoviris.

Kelobonye, K, Zhoua, H, McCarney, G & Xia, J, 2020. Measuring the accessibility and spatial equity of urban services under T competition using the cumulative opportunities measure. *Journal of Transport Geography,* 85. Available at: https://doi.org/10.1016/j.jtrangeo.2020.102706.

Levinson, D, 2010. Equity Effects of Road Pricing: A Review. *Transport Reviews,* 30(1): 33-57.

Litman, T, 2002. Evaluating Transportation Equity. *World Transport Policy & Practice,* 8(2): 50-65.

Litman, T, 2008. Win-Win Transportation Solutions. *VTPI*.

Litman, T, 2021. *Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transport Planning.* Victoria Transport Policy Institute.

Mahadevia, D, 2001. Sustainable Urban Development in India: An Inclusive Perspective. *Development in Practice,* 11(2/3):242-249. doi: 10.1080109614520120056388.

Mahadevia, D, Joshi, R & Datey, A, 2013. *Low-Carbon Mobility in India and the Challenges of Social Inclusion: Bus Rapid Transit (BRT) Case Studies in India.* Ahmedabad: CEPT University Centre for Urban Equity, UNEP.

MoUD, 2012. *Recommendations of Working Group on Urban Transport for 12th Five Year Plan.* Ministry of Urban Development Government of India.

Nicolas, JP, Pocheta, P & Poimboeuf, H, 2003. Towards sustainable mobility indicators: Application to the Lyons conurbation. *Transport Policy,* 10:197-208.

Nuworsoo, C, Golub, A & Deakin, E, 2009. Analyzing Equity Impacts of Transit Fare Changes: Case Study of Alameda-Contra Costa Transit, California. *Evaluation and Program Planning,* 32(4):360-368. doi: 10.1016/j.evalprogplan.2009.06.009.

Pereira, R, Banister, D, Schwanen, T & Wessel, N, 2019. Distributional efects of transport policies on inequalities in access to opportunities in Rio de Janeiro. *Journal of Transport Land Use,* 12(1):741-764.

Press Trust of India, 2014. Fresh notification on banning cycles in Kolkata. *The Hindu*.

Pucher, J, 1981. Equity in Transit Finance: Distribution of Transit Subsidy Benefits and Costs Among Income Classes. *Journal of the American Planning Association,* 46(4):387-407.

Rawls, J, 1971. *A Theory of Justice.* The Belknap Press of Harvard University Press.

Robinson, G. 2010. *Building on the Strength of Environmental Justice in Transportation, Environmental Justice and Transportation Toolkit.* Washington, DC: U.S Department of Transportation Federal Transit Administration.

Rodier, C, Abraham, JE, Dix, BN & Hunt, JD, 2010. *Equity Analysis of Land Use and Transport Plans Using an Integrated Spatial Model.* Mineta Transportation Institute.

Schweitzer, L, 2009. *The Empirical Research on the Social Equity of Gas Taxes, Emissions Fees, and Congestion Charges.* Committee on the Equity Implications of Evolving Transportation Finance Mechanisms. Washington, DC: Transportation Research Board.

Schweitzer, L & Taylor, BD, 2008. Just pricing: The distributional effects of congestion pricing and sales taxes. *Transportation,* 35:797-812.

Sharma, D & Tomar, S, 2010. Mainstreaming climate change adaptation in Indian cities. *Environ Urban,* 22(2):451-465.

Society of Manufacturers of Electric Vehicles, 2019. *EV market scenario India*.

Sun, Z & Zacharias, J, 2020. Transport equity as relative accessibility in a megacity: Beijing. *Transport Policy,* 92:8-19. Available at: https://doi.org/10.1016/j.tranpol.2020.03.016.

Titheridge, H, Mackett, R, Christie, N & Hernandez, O, 2014. *Transport and poverty: A review of the evidence.* London: University College London.

UITP, 2020. *Full free fare public transport: Objectives and alternatives.* Brussels: UITP.

Venter, C, Jennings, G, Hidalgo, D & Pineda, AF, 2017. The equity impacts of bus rapid transit: A review of the evidence, and implications for sustainable transport. *International Journal of Sustainable Transportation*, 140-152. doi: 10.1080/15568318.2017.1340528.

Verma, A & Rahul, T. 2014. Sustainability impact assessment of transportation policies – A case study for Bangalore city. *World Conference on Transport Research Society*.

Weisbrod, DJ, 2001. *Guidebook for Assessing the Social and Economic Effects of Transportation Projects.* Transportation Research Board. NCHRP Report 456.

World Commission on Environment and Development. 1987. *Our Common Future.* Oxford, UK: Oxford University Press.