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Overview

Developing the logical cross-sectoral framework of local SDGs project targeting safety and sustainability

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ABSTRACT

Localization of sustainable development goals (SDGs) was given a boost at the 2019 Seville commitment, which highlighted the importance of local governments on sustainability. Various cities worldwide are at different stages of the localization program. Therefore, in this paper, we discuss two small cities in India that have advanced towards collectively achieving certain targets in SDGs 3, 9, and 11, despite having a small budget, limited human resources, and less international exposure. By utilizing the plan, do, access or analyze, report, and utilize (PDARU) cycle and logic model, we accessed the methods that led to the development of SDG-oriented street designs. The findings show that consensus building of different stakeholders eases data collection and analysis. Residents are adamant to adopt SDGs, but once they are sensitized, they become willing to contribute towards their realization. This exchange of ideas among different government sectors and the residents depicts a cross-sectoral cooperation that is a backbone in localizing SDGs. Despite the fact that social and environmental issues are more dire today, residents understand economic issues better because they directly affect their livelihood in the short run. Therefore, to set realistic localized goals, baselines must reflect residents' short and long-term requirements. Furthermore, by focusing on the top three problems of the locality, other problems are either directly or indirectly addressed. To create a similar strategy in other cities, a back-casting Theory of Change was adopted to propose a methodology for implementation.

1. Introduction

The local context is an important aspect of sustainable development because the problems and their intensities vary based on the locality. Sustainability is a great context because it enables cities to tackle various local challenges using a single approach, leading to better planning, effective resource allocation, and meaningful implementation. Therefore, it is important to learn from what other cities have implemented so far. This increases the body of knowledge on the localization of sustainable development goals (SDGs) and expands the methodologies and practices in attaining them.

In many developing countries, some of the biggest problems are traffic congestion, air pollution, and road traffic accidents. When closely examined, these three problems are closely linked to poor transport system and haphazard urban land use. Therefore, by designing a sustainable transport system, these three problems can be addressed.

In the past, traffic congestion [1] in different cities was reduced by using road-pricing methods, introducing bicycle-sharing programs, and implementing bus rapid transit (BRT) systems. Conversely, the solutions to road accidents were technical in nature, but social approaches, such as the Vision Zero policy [2], were employed alongside technical methods. Furthermore, air pollution is being tackled on a sector-by-sector basis through methods, such as extending the use of solar, wind, and hydropower, and shifting to walking and cycling.

Although these methods have been effective, moving forward, cities should opt for more collective solutions, such as SDG-oriented street designs. These designs are a form of "smart streets", which reduce the reliance of a city on vehicles while making it more attractive for walking and cycling. Furthermore, the streets are designed to cater to people with all facilities and enable economic activities that benefit the local residents. Accordingly, the city becomes livable and enjoyable, and the residents feel a sense of ownership because the streets are centered on their immediate demands.

This kind of urban planning is known as Machizukuri [3], a concept coined as far back as the 1950s, from the Japanese words "Machi" and "Zukuri". "Machi" refers to community but more often "a small area" community as opposed to a large area. While "Zukuri" means building, making, creating or planning. Evans [4] further emphasizes that

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machizukuri encompasses the cross-sectoral collaborative activities between local residents and government entities to create a livable and sustainable city tied to the residents' desires.

Moving forward, such collaborative efforts must also focus on how the city will address the Priority, Speed and Comprehension/Compactness (PSC) criteria. Sustainability of cities dictates that vulnerable people are catered for and prioritized as is the current trend in ensuring safety of vulnerable road users. In addition, the speeds used by motorized vehicles should be checked to ensure that others road users feel safe, or lower speed transport modes must be encouraged. Furthermore, the cities should be such that both residents and non-residents move around with ease. And finally compactness should be considered in order to cater for the needs of all economic and social activities particular to the locality.

PSC criteria was utilized to evaluate the causes of accidents and their respective solutions in two highly regional cities [5], both of which had a high fatality of bicyclists and pedestrians respectively. In both cities, measures had been taken to curb the fatalities. However, it is until the residents were invited to the discussion table that more genuine causes of accidents and solutions were zeroed upon. These two cities, through the town meeting and workshops, exemplify the role and importance of cross-sectoral cooperation in creating sustainable solutions that all stakeholders support.

In another study, PSC and the 3Es (Engineering, Education and Enforcement) was used to propose a new cross sector cooperation approach towards road safety. It was shown [6] that the gaps in some national road safety policies would be plugged by being purposeful about creating road safety solutions that addressed causes of accidents based on the PSC criteria. To attain sustainability goals, government stakeholders should be open to new approaches in decision-making.

1.1. Literature review

Local and regional governments worldwide have already started working towards achieving SDGs 4, 8, 18, 13, 16, and 17. United Cities and Local Government association [7] reported that local and regional governments (LRGs) in European, African, and Latin American countries have been most inclusive in mobilizing and training members with respect to SDGs. Asia, however, has started to be more active through cooperation forums, such as ASEAN.

The benefits of localization are numerous, one of the major ones being the enablement of governments to create tailor-made strategies for local areas. With the fourth industrial revolution upon us, digitalization is an important component of localization. Elmassah and Mohieldin [8] noted that digitalization enabled governments to collect adequate data that forms the basis for decision makers to allocate budgets that meet the most important needs of the locale.

Despite these benefits, many governments complain about shortages in staff and financial resources. Region 42,018 Report [9] noted that approximately 45% of respondent regional governments found it difficult to prioritize SDGs over other agendas, while 32% required additional capacity to train staff and more financial resources to execute different programs.

Some scholars suggest that the first step towards localizing SDGs is to understand the local problems and then utilize local resources to resolve them. Obura [10] mentioned education/awareness, traditional and local institutions, and partnerships as the three major components of attaining SDGs related to blue economy. This is re-echoed by Almeida [11], who developed a conceptual framework and distinct indicators that Brazilian cities can use to track the progress of SDG 11.

Other scholars have also proposed that national and local governments must focus on SDGs that are of domestic importance instead of attempting to achieve multiple goals simultaneously. Horn and Grugel [12] proposed that Ecuador focuses on SDG 10 (target 10.2) and SDG 11.

Many strategies have been proposed in many publications. However, in 2018, the Asian Development Bank (ADB) noted that there is no single approach to localization; therefore, each locale [13] should determine suitable strategies. In addition, governments should exhibit strong commitment towards supporting these initiatives.

In addition, cities should take the initiative to cooperate and learn from each other. The International Institute of Sustainable Development (IISD) reported that Hawaii, Kelowna, Baltimore, and Winnipeg cities were already moving towards localizing SDGs. Because these cities had certain similar challenges [14], IISD encourages cities to have partnerships that enable them to learn from each other.

Therefore, the purpose of this paper is to highlight how two small cities in India managed to utilize their limited resources to create SDG-oriented street designs to achieve SDGs 3, 9, and 11. This paper thus proposes an approach to enable similar-sized cities with limited resources to create SDG-oriented solutions, thereby enabling them to tackle local problems.

2. Proposed methodology for the localization of SDGs

In this study, three main methods were utilized: document review, logic framework, and Theory of Change (ToC). Document review enabled the authors to gather information about the processes that lead to the localization of SDGs. Logic framework is a visual tool used to illustrate how stakeholders and inputs interact to create final outputs of the project. This tool was used in conjunction with the plan, do, access or analyze, report, and utilize (PDARU) cycle to assess the social impact of the decisions made towards formulating a localized SDG solution.

To replicate the above effect, ToC was utilized to identify the inputs that can be used to create similar outputs in another region with similar characteristics.

2.1. General PDARU cycle

The PDARU cycle is a process used by project donors and funders to ascertain if there is a tangible change brought about by the funded project. Second, it is used to visualize the value created by the utilization of the wisdom and technology employed by the private sector to solve social issues. This cycle is preferred to the traditional PDCA cycle because PDCA is closed internal quality control process. While PDARU incorporates "Reporting and Utilization" to make the process open and more inclusive. By opening up the process, trust is built, more inclusive discussions are held which lead to generation of tailor-made solutions that other communities can learn from. Fig. 1 presents an illustration of the cycle.

Hirano et al. [15] utilized PDARU and a logic model to assess the necessity and effectiveness of public transport in Shodoshima, Japan. The authors concluded that buses enabled residents to go out independently; improved relationships with family and friends; and

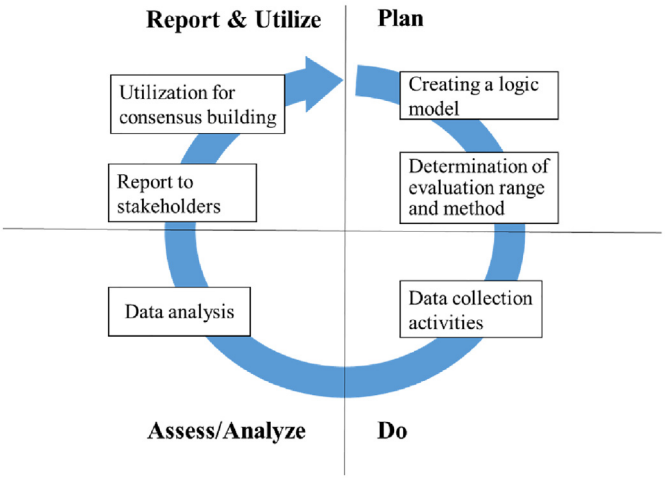

Fig. 1. Social impact assessment cycle.

improved the well-being of individuals and the region. This highlighted the extent of social impact of the investment into the olive bus program among the people living in Shodoshima. This is a successful example of the localization of SDGs, which can be viewed as the contribution of public transport towards improved mobility and access, regional revitalization, improved health, and relations among residents.

From the review of reports [16,17], the PDARU Cycle for Patiala and Bulandshahr is described as follows.

2.1.1. Planning

Planning is the first step of the PDARU cycle. Here, the logic model is created to include short, middle and long-term goals. In addition, the evaluation range and methods to be used are agreed upon by all stakeholders.

For the projects in India, for instance, to understand the main challenges in Bulandshahr and Patiala, the Transport Research & Injury Prevention Programme (TRIPP) at the Indian Institute of Technology (IIT) identified a team of professionals and researchers. TRIPP [37] is an interdisciplinary program conducted at the Indian Institute of technology, its aim is to "reduce the adverse health effects of road transport in order to promote safety, clean air and energy conservation." Some of TRIPP's activities include workshops and special research projects where planning and design of urban, transportation systems and infrastructure is tackled. This team therefore, identified and classified the major challenges in the two cities as air pollution, traffic congestion, and road traffic accidents. To create a way forward, the collection of baseline data, which included traffic safety data, road network data, air quality data, and travel patterns, from relevant stakeholders was deemed critical.

2.1.2. Do

During this stage, the planned activities from the planning stage are executed using the methods agreed upon. In these two cities, the traffic safety data were collected from local police stations and coded onto a GIS base. Road network data were collected, digitized, and imported onto a GIS base. Travel patterns on travel to work were collected from the 2011 census. Air quality data was collected from the monitoring station in each city. A small-scale perception survey was also conducted in both cities to understand the views of traffic and mobility problems of the users.

The perception survey [16,17] was carried out to understand the community's comprehension of mobility problems. A survey containing 23 key questions about congestion, safety and air pollution issues was prepared by TRIPP and distributed in both cities. The survey was distributed, with the help of local NGOs, to students, business community and administrative staff.

2.1.3. Assess/analyze

Analysis is an important step, because the results got are the baseline on which decision are made. For Bulandhshar and Patiala cites, the data collected from the step above was analyzed, and the following were found.

i. Annual fatalities were 62 and 19 for Patiala and Bulandshahr, respectively.
ii. Public transport use in both cities was approximately 11%. In Bulandshahr, approximately 48% of the population prefer walking to work. In Palatia, 80% of the population either walks, cycles, or uses a motorbike.
iii. Air quality in both cities was extremely poor.
iv. In both cities, the biggest challenges noted were traffic congestion, road safety, air pollution, vehicular parking, and inadequate pedestrian facilities.

2.1.4. Report and utilize

The emphasis at this stage is that the reporting is done in the simplest form so that all stakeholders understand the results. Once the reporting is done, the stakeholders discussion how to utilize the results to their shared benefit. Therefore, innovation and creativity are key in reporting.

For these two cities, the entire project was phased into three parts, and a report was written for each and disseminated to relevant state and national-level stakeholders [16 and 17]. In addition, SDG-oriented street design guidelines were discussed and published for both cities. These guidelines will be the focus of the next chapter.

2.2. Logic framework

A logic framework can be defined as an overview of the inputs, outputs, and outcomes of a project. Each stage of the logical framework ties into a stage of the PDARU cycle. Fig. 2 demonstrates a localized SDG perspective of a logic framework.

At the input stage, planning should be done based on regional resources. When deciding on activities to collect or access the data, it should be ensured that the situation of the locality is considered. The outputs should be such that the requirements of all the people are considered. The outcomes should be easy for everyone to internalize and, hence, visualize the expected impact.

Fig. 3 presents a detailed logic framework, which is divided into process and output sides [18]. To create a similar outcome in another area, a ToC is utilized to outline a stepwise pathway to identify events, requirements, and assumptions as well as how all these interact to generate a desired outcome.

There are various definitions of a ToC depending on the situation. Chen [19] describes "theories of change as models of how change is expected to happen or how change has happened." The Center for ToC [20] defines it as "a comprehensive description and illustration of how and why a desired change is expected to happen in a particular context." They emphasize that ToC focuses on "filling in the missing middle," between what a project does and how it achieves desired goals.

Fig. 4 illustrates a simple ToC visual created from the definitions of casual links that Mayne [21] described. ToC models are common among development organizations whose primary focus is education, health, sanitation, and poverty alleviation. Organizations, such as Department for International Development (DFID) [22], have utilized them in Ethiopia, India, DRC, and other areas. ToCs have been instrumental in identifying a local problem and local resources, mapping out desired outcomes, and showing what factors can be employed to meet a particular goal.

ToC has also been utilized in the transport sector. The HTC group [23] is a leading social enterprise that provides bus services to create social impact in their communities. Their ToC is designed to meet their mission; therefore, the company adjusts its activities regularly to meet their set outcomes. In this study, the ToC shows how localized SDGs can be replicated in other cities to reduce traffic congestion, road traffic accidents, and air pollution.

3. Case study: SDG-oriented street designs in Patiala and Bulandshahr cities

3.1. Background of the cities

India is one of the world's fastest growing economies and the world's second largest democracy standing at a population [24] of approximately 1.36 billion as of 2019. Some of the issues facing India include air pollution, traffic congestion, road accident death, and poverty.

It was reported that the population-weighted mean annual ambient PM 2.5 exposures in India [25], as of 2015, was 55 μg m^{-3} in some areas and more than 100 μg m^{-3} in others. These values are 5–10 times higher than the levels recommended by WHO (10 μg m^{-3}). Some of the proposed solutions [26] to reduce air pollution includes switching to clean energy sources for stoves, raising fuel taxes and parking fees, and levying congestion charges among others.

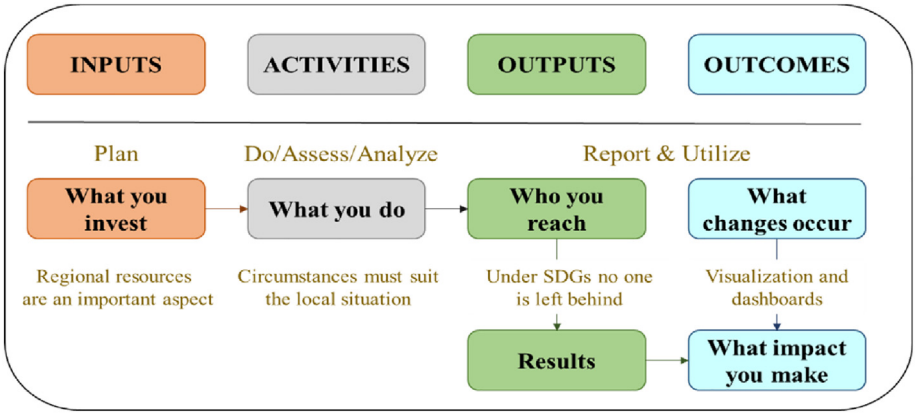

Fig. 2. Simple illustration of a localized SDG based logic Framework.

Road traffic accidents [27] in India stand at an estimated fatality rate of 22.6 per 100,000 people as compared to the South East Asia average of 20.7, with a world average of 18.2 per 100,000 people. In 2019, it was reported that the passage of the amended Motor Vehicle Act [28] led to a 10% reduction in the number of deaths caused by accidents in India. Over-speeding is reported to be the biggest cause of road accidents; therefore, the government of India proposed the opening of 1000 driving schools in the country. In addition, there have been road safety campaigns, such as the Indian Road Safety Campaign [29] that started in 2014, to improve the safety of students.

Approximately 30% of India's urban population lives in small cities, many of which face similar challenges in varying degrees. Therefore, the diversity of Indian cities and India's position on the world stage, where on one hand it is on the developing scale and the other on the developed scale, presents an interesting case study. Therefore, many lessons can be learnt from these cities and adapted other in cities with similar conditions.

Two small cities in India have already set up a localized SDG road map in the form of SDG-oriented street design guidelines. Patiala and Bulandshahr have a population of approximately 500,000 people according to a final report submitted by TRIPP [30,31]. Patiala is the fourth largest city of Punjab and is the administrative headquarters of the Patiala district. Bulandshahr is located about 60 km from New Delhi, thereby being a part of the National Capital Region of Delhi.

There are 62 annual fatalities in Patiala [30] and 19 annual fatalities in Bulandshahr [31]. Furthermore, over 75% of fatalities in both cities are vulnerable road users. The use of public transport is still low at approximately 11% in Patiala and Bulandshahr. Therefore, these two cities were studied to understand the process that led to the decision to create SDG-oriented street designs.

3.2. Perception study

Section 2 outlines the results obtained from data collection and analysis conducted by TRIPP. This section examines the perception study in both cities. Fig. 5 presents the results. Social, environmental, and economic (SEE) are the three dimensions of sustainable development. Notably, the biggest challenges of these two cities are as diverse as these three dimensions.

Traffic congestion is a global problem, and of the top ten most congested cities [32], four are from India. In 2018, it was reported that congestion in Mumbai, Bengaluru, Kolkata, and Delhi cost the Indian economy [33] about Rs 1.5 lakh crore (approximately $200 billion) annually. Bulandshahr and Patiala are smaller compared to these four cities. Even though there is no conclusive data regarding the cost of traffic congestion in Bulandshahr and Patiala, we can estimate that the loss is sufficiently large to cause a dent in the nation's economy. Reduction of traffic congestion would move these cities closer to attaining SDG 11, target 11.2, which calls for provision of access to safe, affordable, accessible, and sustainable transport systems for all.

The second biggest challenge in both cities is road safety. According to the "Road Accidents in India report 2018" [34], India ranks first globally as the country with the highest number of road accident deaths. It also accounts for 11% of accident-related deaths in the world. Furthermore, young people in the age group of 18–45 years account for 69% of all road accident victims. These statistics provide insight on the social grief, loss, and disruption that road accidents cause in India.

A study commissioned by India's transport and highway ministry [38] estimated that the socio-economic cost of road accident fatalities and injuries was about Rs. 1.47 lakh crore (approximately $20.3 billion) in 2018. The cost of a victim left with major injuries was about Rs 3.6 lakh (approximately $4976) per individual. Putting into consideration under reporting, the report estimated the loss due to fatalities and injuries to be at Rs. 5.9 lakh crores (approximately $81.5 billion), 3.1% of the GDP. It is, therefore, not surprising that this disruption is felt across the country and not just in larger cities. Improving road safety would ensure that cities attain SDG 3, target 3.6.

The third biggest concern of these cities is air pollution. IQAir [35] ranking of the world's most polluted cities showed that 14 of the top 20 cities are in India. Each of them had an annual PM 2.5 concentration

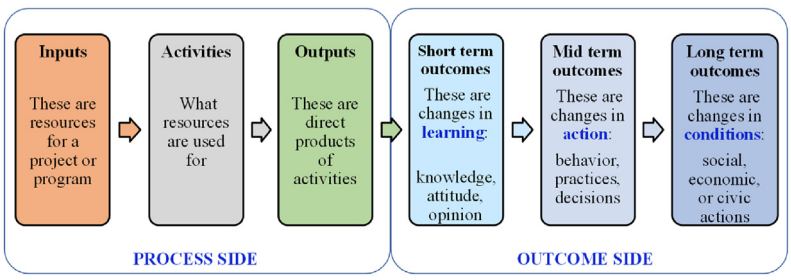

Fig. 3. Detailed logic model.

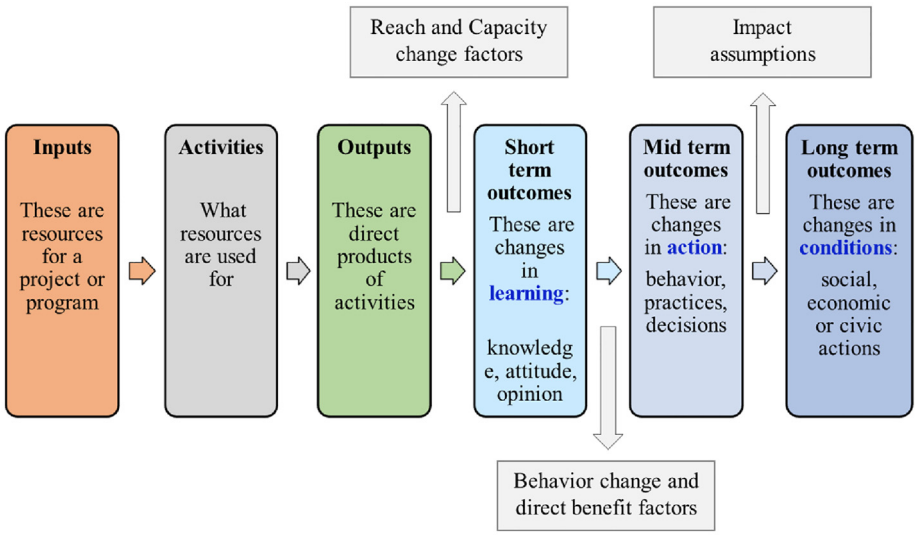

Fig. 4. Simple illustration of a Theory of Change.

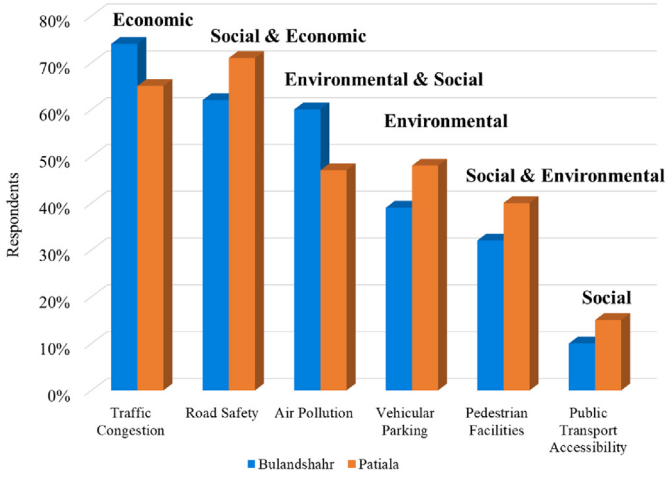

Fig. 5. Results of the perception study in Bulandshahr and Patiala cities.

of more than 83 μg m^{-3}, which is eight times higher than the WHO recommended annual concentration of 10 μg m^{-3}. Bulandshahr and Patiala were ranked 13 and 310, with an annual PM 2.5 concentration of 89.4 μg m^{-3} and 35.2 μg m^{-3}, respectively.

Air pollution is not only a threat to the environment, but also to our health. In 2016, WHO [36] reported that 4.2 million premature deaths occurred due to outdoor air pollution. Therefore, reduction of air pollution would reduce the burden of diseases, such as stroke, heart disease, lung cancer, and asthma. The attainment of this goal would fulfill SDG 3, target 3.9.

Table 1
Summary of challenges, SDG pillars, and target in the two cities.

S/N	Major challenge	Sustainability pillar	SDG target(s) to achieve
1	Traffic congestion	Economic	11.2
2	Road Safety	Social and Economic	3.6
3	Air pollution	Environmental and Social	3.9, 11.6
4	Vehicular parking	Environmental	11.7
5	Pedestrian facilities	Social and Environmental	11.7
6	Public transport accessibility	Social	11.2, 9.1

The largest percentage of residents in Bulandshahr and Patiala cities walk, cycle, or use motorcycles. However, the roads have no proper sidewalks, there is no segregation of traffic, street parking is a menace, and there are insufficient basic amenities among other problems. Furthermore, many residents engage in informal activities, such as vending and hawking. To improve liveliness and safety among people, the streets must provide a conducive environment for walking and green spaces for relaxation and access. Therefore, achievement of SDG 9, target 9.1, and SDG 11, target 11.7, would solve many of the aforementioned challenges. Table 1 summarizes section 3.2.

3.3. Way forward for Patiala and Bulandshahr

The perception study clearly outlines the main problems faced in each city, but it also reveals an opportunity in the form of sustainable goals to be achieved. Accordingly, SDG-oriented streets were the solution agreed upon by the stakeholders in each city.

Fig. 6 below summarizes the components of the SDGs-oriented street design. Providing pedestrian walkways and cycle lanes would separate these vulnerable road users from motorized traffic, this is expected to reduce the rate of accidents involving vulnerable road users. In so doing, these cities will be moving close achieving SDG 3.6 that calls for the halving of global deaths and injuries due to road traffic accidents.

The current share of public transport in both cities is less than 11%, the new design caters for Non-Motorized Transportation (NMT), extending the public transport corridors and providing facilities such as resting areas and parking areas near public transport stops. This would increase the number of people accessing public transport hence moving towards achieving SDG 9.1 and 11.2. Both these goals aim at increasing the convenience and access of people (especially those in rural areas) to public transportation.

The SDGs oriented street designs have include preservation of existing green belts and creation of new green belts along the roads, medians and waiting areas. The design also provides spaces for hawkers and vendors to sell their goods, resting spaces, proper parking spaces, and facilities for disabled persons and lighting for the night. These provisions increases the number of safe, inclusive and accessible public spaces open to the public, as is required by SDG 11.7.1.

By improving the road network, road junctions, encouraging public transport and NMT, the exhaust gases from vehicles are expected to reduce the amount of air and noise pollution in these cities. Thereby reducing mortality rates due to ambient air pollution and fine particular

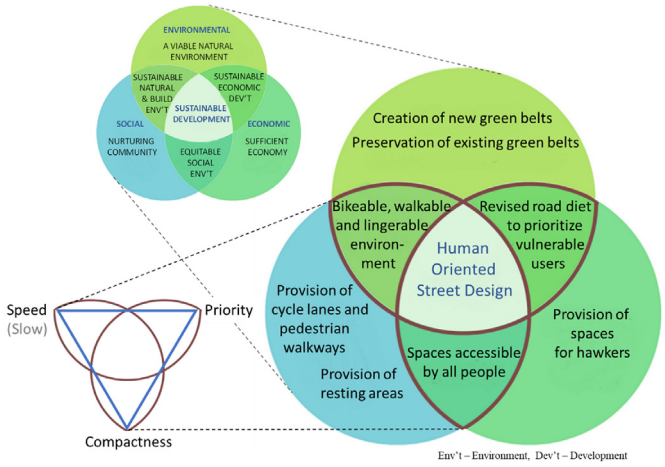

Fig. 6. Cross-Sectoral areas of street-related local SDGs and their correspondence to PSC criteria.

matter in the atmosphere. In this way, the cities will be moving closer to achieving SDG 3.9.1 and 11.6.2.

Not all countries in Asia have embarked on creating national and local guidelines for implementing SDGs. However, Japan [39] has created both national and local guidelines with clear stated priorities referencing the 5Ps (People, Prosperity, Planet, Peace and Partnerships) of SDGs. Some of these priorities were referenced in this study to elaborate the merits of localizing SDGs. Table 2 shows priorities relevant to this study and how they are summarized in this study.

Based on the "referenced items in this study", the merits of localizing SDGs are expounded upon in Tables 3 and 4. These tables show how pertinent challenges in Patiala and Bulandshahr were addressed by the SDG-oriented streets.

The SDG-oriented streets are a representation of the Social, Economy and Environmental (SEE) pillars of SDGs. The upper-left figure in Fig. 6 shows the general overview of SEE while the lower-right is a representation of how SDG-oriented streets address the primary challenges, their alignment with SEE and priority, speed and compactness (PSC) criteria.

Tables 3 and 4 show that initially the relationship among different stakeholders was not clearly defined until this SDGs oriented project started. This cross-sectoral interaction of various stakeholders and residents is an important ingredient in creating baselines and proposing solutions. This is expounded upon in section 3.4.

For these two cities, distinct transport machizukri manifests itself in the general solutions proposed to improve the social, environmental and economic situation of the residents (see Fig. 6 above). Solutions such as spaces for hawkers is deemed to boost the economic situation of the residents. Secondly, majority of the people in this city either walk or cycle, therefore, provision of cycle lanes and pedestrian walkways will not only improve safety of users but also increase the number of people who might opt for these modes of transport. The move to create more green belts and preserve existing ones will contribute to improving the air quality and beauty of the cities.

On the other hand, PSC criteria details solutions that arise from cross-sectoral cooperation efforts. Firstly, cycle lanes and pedestrian walkways would not only provide a safe means of transport but also

Table 2
Some of Japan's SDG priorities that are referenced in this study.

Priorities outlined by Japan	Reference in this study
People	Improvement of people's Quality of life (QoL)
1. Empowerment of all people	
2. Achievement of good health and longevity	
Prosperity	
3. Creating growth markets, revitalization of rural areas and promoting technological innovation	
4. Sustainable and resilient land use, promoting quality infrastructure	Development of distinct (transportation) machizukuri solutions
Partnerships	Promoting partnerships among domestic stakeholders
5. Strengthening the means and frameworks of the implementation of the SDGs	

Table 3
Merits of localizing SDGs in Patiala City.

Items to consider	Patiala city (current)	Patiala city (SDGs focus)
1. Improvement of the QoL of citizens in terms of: a) Material living conditions b) Productivity or main activity	Inadequate industries or manufacturing units to engage many people in informal activities, such as vending items and hawking	Integrating places for hawkers and vendors into the street designs and providing them with adequate lighting. (SDG 9.1)
2. Distinct transport machizukuri	• There is no defined public transport means in Patiala • There are some footpaths but many are not well maintained • Non-Motorized Transport (NMT) is the most commonly used form of public transport but its network is not well detailed	• The need to increase public transport share from 0% to 45% (SDG 11.2 and 9.1) • Increase footpath coverage from 70% to 100% (SDG 11.7) • Increase NMT from 35% to 45% (SDG 11.2 and 9.1) • Development of a detailed inventory of NMT infrastructure (SDG 11.2 and 9.1)
3. Cooperation among various stakeholders	Not clearly defined	Consultations with (SDG 17.16); • Patiala Urban Planning and Development authority • Police Department • Public works department

Table 4
Merits of localizing SDGs in Bulandshahr City.

Items to consider	Bulandshahr city (Current)	Bulandshahr city (SDGs focus)
1. Improvement of the QoL of citizens in terms of: a) Accessibility b) Health c) Natural and living environment	According to a survey, 70% of the people admit that climate change is affecting the area and 47% believe that motorized vehicles contribute to greenhouse gases	• Provide universal access to safe, inclusive, accessible, green, and public spaces (SDG 11.7) • Monitoring air pollution and particulate matter. (SDG 3.9 and 11.6)
2. Distinct transport machizukuri	Currently vendors and hawkers stand along roads to provide services to bus commuters, cyclists and pedestrians	In the redesign of streets and roads, there is a provision for hawkers and vendors (SDG 9.1)
3. Cooperation among various stakeholders	Not clearly defined	Consultations with (SDG 17.16); • Bulandshar Khurja Development Authority (BKDA) • Police Department • State Transportation Department

attract residents to explore the city at a more relaxed pace (slow speeds). Secondly, revision of the road diet to prioritize vulnerable road users enables them to move freely in the city but to also access service providers such as hawkers. Thirdly, provision of rest-areas and spaces for hawkers (compactness) provides an opportunity for the residents to organically socialize and access services providers. These three examples explain the tangible and intangible benefits of cross-sector cooperation solutions that revolve around the PSC criteria.

3.4. Logic model for Patiala and Bulandshahr

The information obtained from the reports and design guidelines for the SDG-oriented streets brings us full circle to the planning phase of the PDARU cycle. In this section, we examine the logic model that led to these results. In doing so, other cities of similar size or in similar situations can learn a few things from these successes.

3.4.1. Process side

At the input stage, a large amount of local human resources is required, which might be in the form of local authorities, researchers, and residents. Building consensus among various stakeholders lays the foundation of how the project will proceed. Therefore, good relations have to be formed from the inception of the project.

The activities stage involves numerous data collection to enable the team to understand the problem faced in their locality. At this point, the local agenda starts to form. In the case of Patiala and Bulandshahr, the activities included gathering data on the master plan of the city to grasp the general direction of the local government. Air pollution and road accident data were also collected from relevant authorities to ascertain a baseline to work with. The ease of collection of this data was facilitated by the involvement of these authorities from the beginning. The involvement of residents through activities, such as perception studies, broadens the team's overview of the problem. This is important because as end users, they know what is “broken” and in most cases know what will work for them.

The activities have to be planned appropriately to ensure that the outputs are meaningful for the advancement of the project. In the case of these two cities, the outputs were utilized to establish long-term goals for each city. Accident incident maps and dashboards were created to visualize and monitor road crashes. The team used this information to decide how much the target reduction would be. Air pollution and particulate matter data were also reviewed to form a baseline for future action. Another important output was the visualization of the citizen's biggest concern, as summarized in Fig. 5. This enables the authorities to align their work with the requirements of the resident.

3.4.2. Outcome side

In the short run, a lot of learning is done from the activities mentioned above. In the case of the two cities, the citizens got to understand what SDGs are, how they relate to their situation, how they could be achieved in their communities, and their role as citizens in realizing the SDGs. This provided them a sense of ownership of the project and thus, there will be less resistance during implementation. Conversely, the authorities were able to understand the citizens' biggest challenges and what they thought were the most feasible solutions. The TRIPP team became more aware of modal priority towards equitable allocation space. This played a significant role in the decision made for the final street designs.

All the above prompted a lot of action in the practices and decisions taken towards creating SDG-oriented streets. One major change in practice was the suggestion to incorporate road audits from project inception to completion. Another change was improving and promoting walkability, connectivity, and social cohesion of the citizens. As previously mentioned, walking and cycling are the most common modes of transport in the two cities. Therefore, these had to be encouraged through designs that separate different road users, designs to ensure comfortable walkways with lights for nighttime, and trees to shade pedestrians and hawkers. Coherence was another road design aspect introduced to decrease travel time and increase directness for cyclists and pedestrians. Another design plan was to relocate hawkers, vendors, bus shelters, green areas, and resting spaces to make the city more attractive and accessible to all citizens. Fig. 7 demonstrates a logic model representation of the aforementioned aspects, which culminate into:

- Economic vibrancy of the city – SDG target 3.6 and 9.1
- Improved road safety and mobility – SDG targets 3.6, 3.9, 9.1, 11.2, and 11.7
- Better health and well-being - SDG 3.6 and 11.6

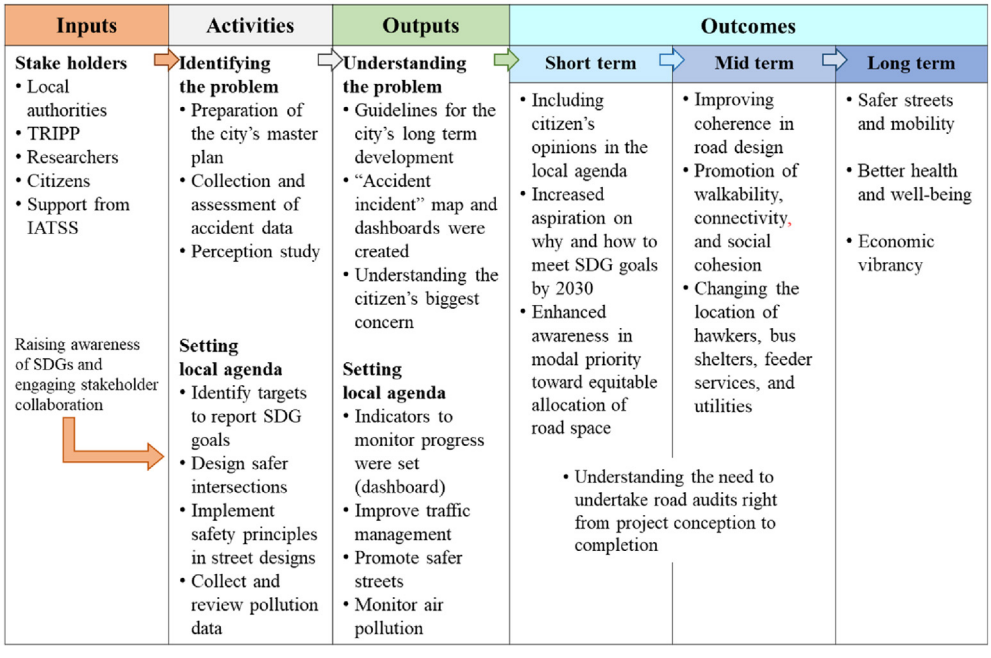

Fig. 7. Logic model for Patiala and Bulandshahr.

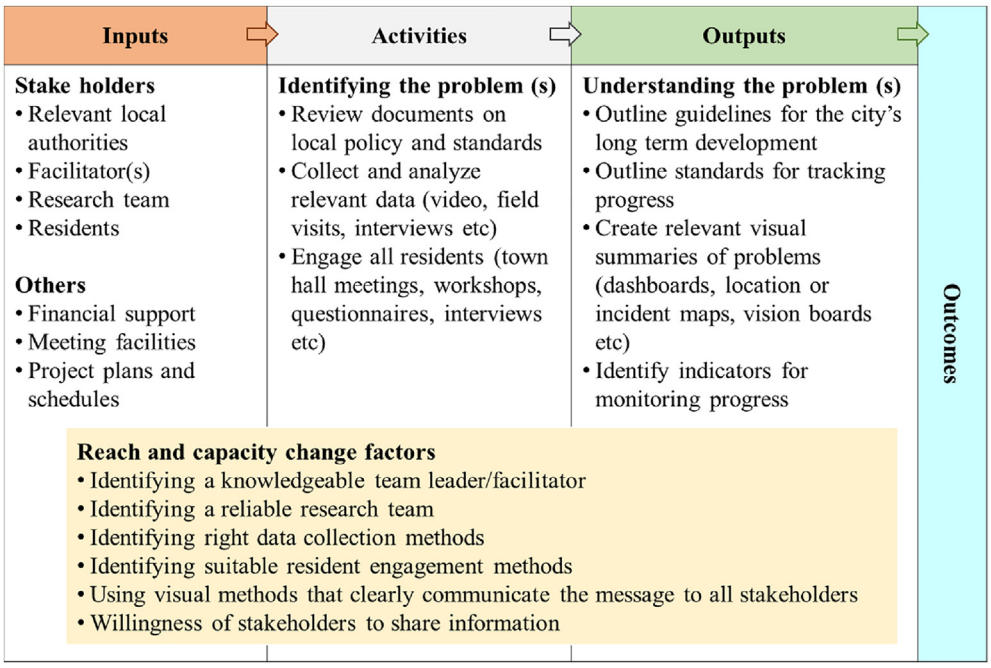

Fig. 8. Proposed theory of change (Process Side).

3.5. Lessons learnt from Patiala and Bulandshahr

Different localities in the world face different challenges, but many of these are similar and are global concerns. Traffic congestion is as daunting in Kampala, as it is in Los Angeles, Lagos, New Delhi, and Paris. Road safety is as challenging in Nairobi as it is in Colombo, Manila, Brasilia, Abidjan, and Moscow. Air pollution is as taxing in Pune as it is in Beijing, Cairo, and Bakersfield.

If one locality develops a solution, it is beneficial for other places to learn from it and implement what works and modify or discard what does not work. Patiala and Bulandshahr are a suitable pilot project for smaller cities that have similar challenges to bigger cities, albeit to a different degree.

To expound on these lessons, a ToC is proposed in Figs. 8 and 9. This is back-cast to show what a team would need to achieve similar goals. These figures show the process and outcome sides, respectively. The items in the bottom boxes represent the underlying conditions required to move the project from one point to the next.

Fig. 10 above is a representation of the Avoid-Shift-Improve A-S-I strategies in both cities. PSC criteria can be utilized to expound upon

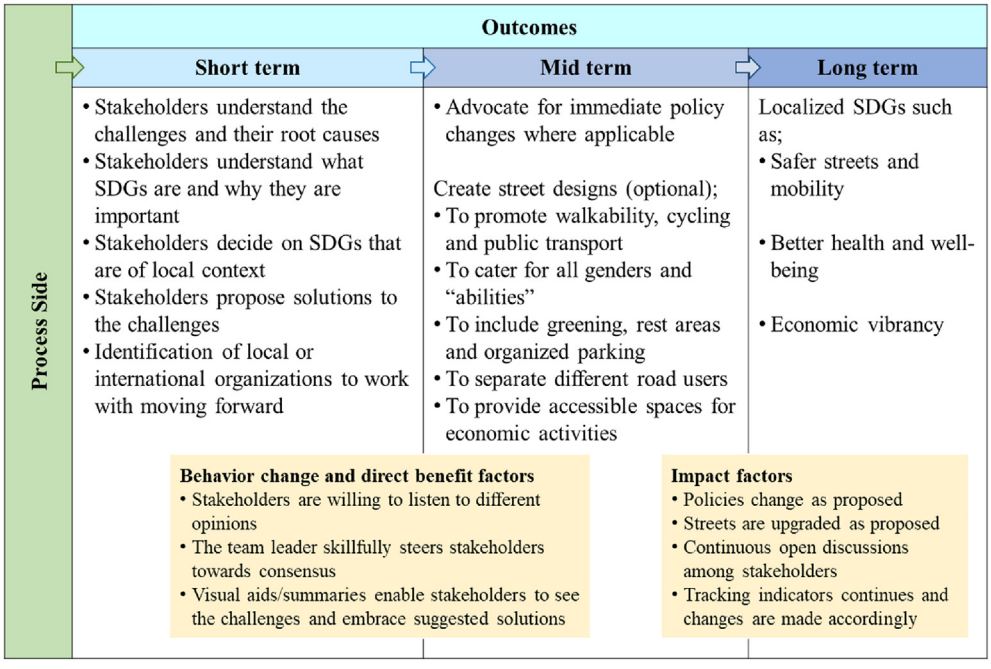

Fig. 9. Proposed theory of change (Outcome Side).

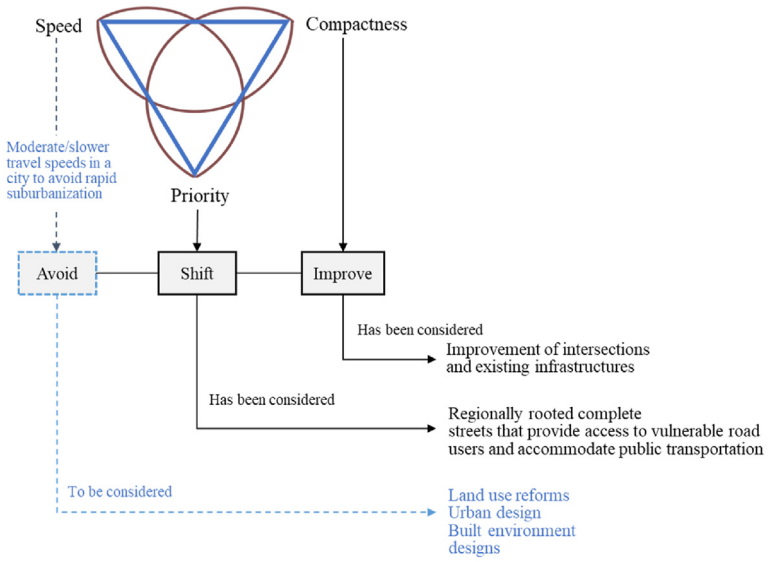

Fig. 10. Avoid-Shift-Improve strategies utilized in Patiala and Bulandshahr.

the A-S-I strategies in achieving sustainability. To improve the road infrastructure, some of the recommended measures are making intersections more compact. Bulandhshar and Patiala cities intend to redesign and upgrade many of their intersections and roads.

The shift strategy is more of a mindset shift because no one should be left behind. Therefore, moving forward vulnerable road users should be the focus of new street designs. This was achieved by both cities with the design to include cycle lanes and pedestrian walks ways as well rest spaces.

Avoid strategies on the other hand, seek to prevent problems such as traffic congestion, urban sprawl and environmental degradation by ensuring that land reforms, urban designs and built environments are carefully carried out. Though, the focus should be to reduce speeds of motorized vehicles or encouraging the use of slower modes of transport. Both cities reported that they would improve the master plan but no details were availed.

On the whole, it should be noted that Improve strategies feed back into Avoid strategies therefore these two must be handled simultaneously to ensure optimal utilization of resources. In the future, other cities should be mindful of logically incorporation these three ideas into sustainability solutions.

4. Discussion

Currently, many sustainability efforts are concentrated in big cities while the smaller cities “have been forgotten”. Additionally, many cities in India are adamant to adopt SDG goals because they feel that these goals might take precedence over local priorities. However, in creating a local sustainability context, many local challenges have been addressed. Patiala and Bulandshahr set a suitable example of cities that utilized local resources, local institutions, and a limited budget to create an SDG-oriented solution to tackle three of their biggest local challenges. Accordingly, they can achieve specific targets in SDGs 3, 9, and 11. We now elaborate on how to recreate similar success in localizing SDGs.

In the planning phase, it is important to select a team of reliable researchers and a capable team leader to execute the project. Both Patiala and Bulandshahr had an experienced team from TRIPP that was able to build consensus with relevant stakeholders. Consensus building at the planning stage creates a firm foundation whose results manifest in the smooth running of the project from start to completion.

The end user of any project is the residents; therefore, suitable engagement methods must be decided upon before the project takes off. As noted earlier, many residents are not familiar with SDGs, so they are unwilling to participate. However, through public engagements and discussions, such as workshops, town hall meetings, or even perception studies, residents can be brought on board.

This process works in favor of both residents and decision makers. The residents understand the SDGs and how they can improve their lives while the decision makers get to understand the most pressing matters. Through such exchanges, cross-sectoral synergies that generate tailor-made solutions are created without a lot of tension, as is the case for many projects. Other cities have also utilized cross-sectoral cooperation to curb the fatalities of vulnerable road users. Therefore, cross-sector cooperation is a tried and tested approach in creating sustainable solutions.

Furthermore, the involvement of residents in setting local goals and indicators is an eye-opener to decision makers. The results reveal that the thought process of the residents may differ from that of the decision makers. For example, social and environmental problems are much more critical at this point in human history, but the perception study ranked congestion as the number one challenge. This is because traffic congestion directly translates into economic loss for the people in the short term, while social and environmental challenges manifest themselves in the long run. In India, many residents were unaware of the extent of air pollution despite warnings from experts. Many residents started understanding the peril they were in only after New Delhi was covered in a thick fog for days together.

Similarly, social issues, such as road safety, are just as crucial. However, the residents understand the impact only when it affects them directly. Another social short fall is that women did not actively participate in the perception study, yet they make up about 47% of the population in both cities. This may be due to social norms in these parts of India, but in the spirit of leaving no one behind, women and girls should be provided a platform to express their views as well.

Once the planning phase is completed and various resources are identified, the data collection and analysis phase starts. To have a smooth process, an effective and suitable method of communicating outputs to different stakeholders must also be discussed and decided upon. In the case of Patiala and Bulandshahr, dashboards and incident maps were simple methods that showed both the decision makers and the residents the extent of the problems in their cities. This

visualization not only enables all stakeholders to grasp the situation, but also visualizes the proposed solutions.

The next important phase is the determination of a sustainable solution that can deal with the top three problems in the locality. This solution should be backed by baseline data and propelled by specific goals. Patiala and Bulandshahr zeroed on SDG-oriented streets with the aim of making streets safer and accessible to all people, improving the health of residents and boosting economic vibrancy. Such specific goals become the blue print on which the solutions are created.

SDG-oriented streets are a relatively new idea and, in order for them to be realized, mindsets have to change. Stakeholders must be willing to listen to all ideas and opinions so that the most effective solution is carried forward. Therefore, some old practices have to be abandoned to realize the goal. Some of the changes in the two cities were to boost walking by increasing footpath coverage from 75% to 100%. This was a huge shift from the current state of mind of a car-dominated environment.

In addition, an efficient system of tracking and reporting different indicators must be agreed upon. Such systems feed into the PDARU cycle, which can be used to continuously make changes that improve the lives of residents. Patiala and Bulandshahr utilized dashboards for the tracking progress.

Residents and government officials working together to solve local challenges is the essence of machizukuri. Despite, the fact that machizukuri has been mainly adopted in revitalization projects in Japan. The concept is applicable in other parts of the world; as is clearly shown through the processes that culminated into the SDGs oriented streets designs proposed by both cities.

Sustainability can also be understood from the priority, speed and compactness (PSC) criteria. Fig. 6 illustrates this by expounding on how cross-sector cooperation solutions can prioritize movement of vulnerable road users, reduce of travel speeds so that residents can explore their city and how compactness provides organic socialization and access to service providers.

Furthermore, PSC criteria expands the understanding of Avoid, shift and improve (A-S-I) strategies. To improve traffic flow and access, road infrastructures should be more compact. Shift strategies aims to change mindsets, therefore efforts should now prioritize vulnerable road users so that no one is left behind. In avoiding, we seek to prevent traffic congestion, urban sprawl and environmental degradation. This can be achieved by ensuring that either motorized vehicles reduce their speeds or slower means of travel are encouraged. In the case of Bulandhsahr and Patiala cities, avoid strategies were merely implied. In the future, cities should critically look at how to incorporate these strategies at the beginning.

In addition, some issues were not clearly addressed in these projects. Despite the fact that air pollution was noted as a major challenge in both cities, specific measures and target reductions were not mentioned in the reports. Other methods, such as government regulation and commitment, were not mentioned. Yet to achieve sustainability, government commitment and intervention are vital. Targets 3.9 and 11.7 were mentioned, but local indicators to track progress were not clearly stated. Moving forward, more specific aims such as, “reduction of deaths due to road accidents by a certain percentage by a certain year” are more concrete goals than merely stating “reduction of death due to road accidents”. Only Patiala mentioned some specific aims in their reports.

Declaration of Competing Interest

None.

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