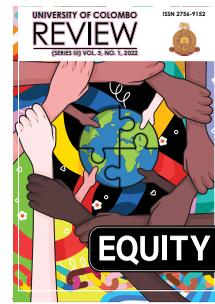


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Contributions of railway services towards socio-economic equity and environmental sustenance: Reflections from post-lockdown restrictions on train operations in the Western Province of Sri Lanka

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ABSTRACT

In Sri Lanka, rail transportation was suspended in the immediate aftermath of COVID-19 lockdowns. This constrained the mobility of low-income groups, resulting in a negative impact on social equity. The present article is an outcome of a research conducted to examine the direct and indirect costs that the nation and the financially vulnerable social groups would have suffered due to the opening up of the economy without passenger train operations in the Western Province. The research adopted the approach of analyzing comparative costs against alternative means of mobility and associated impacts, as its methodology. The outcomes revealed that the travel costs of socially vulnerable segments in the Western Province would have increased by around 140% -500% if they had to use bus travel as the alternative mode of mobility, in the absence of train services, during the one-month period since opening up of the economy after COVID lockdowns. This cost increase would have been much greater had they used the motorcycle mode as the alternative to the railway. Lowest income groups would not have been able to afford such alternative modes of travel because of higher costs, and thus, at least some of them would have had to forego fulfilling their mobility needs; a significant equity implication. On the other hand, if the train travelers in the Western Province managed to meet their mobility needs through bus and motorcycle modes, in the absence of train service, the national economy would have been compelled to incur an estimated additional cost of around USD 0.64 Mn and USD 1.76 Mn, respectively, on fuel imports during the same period of one month. The resultant additional CO₂ emissions also would have been substantial. It is therefore evinced that railway transport is affordable, saves foreign exchange and minimizes environmental pollution, and any failure to maintain train services is bound to be economically costly and socially and environmentally harmful in the long-run.

KEYWORDS:

Rail Transportation, Mobility Needs, Costs of Alternative Modes, Fuel Economics, Social Equity, Externalities, COVID-19, Sri Lanka.

JEL Codes: D63, L92, N75, Q53, R41

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Introduction

Sri Lanka, being a middle-income country, is witnessing an increasing trend of her citizens resorting to private transport modes to meet their mobility needs, even though a significant share still depends on public transportation. New or expanded public transportation options can improve public health and social equity by providing relatively affordable mobility to the general public, reducing traffic congestion and accidents, preventing air pollution, increasing physical activity, and improving access to education, medical care, healthy food, vital services, employment, and social connection [(Heaps, Abramsohn, & Skillen, 2021), (Gunaruwan & Jayasekera, 2015)]. Rail transportation, though its relative mode share has been dwindling over the years, plays an important role in Sri Lanka as one of the most commonly used, affordable and environmentally friendly public transport modes for commuting.

In this context, the health-related restrictions, including social distancing, imposed on public transport to mitigate the spread of the COVID-19 virus have significantly impacted the lives of Sri Lankans. Rail transportation was among the most significantly affected; the number of passengers that used railway transport has nearly halved from 2019 to 2020 (Department of Census and Statistics, 2021). The country opened for public mobility on 1st October 2021 after the COVID-19 related lockdown. Yet, the authorities did not permit the resumption of train services due to the risk of infection resulting from the potential congestion in trains. The train services resumed on a limited basis for season-ticket holders on 21st October 2021. But the restrictions were completely removed only on 1st November 2021.¹

This non-availability of train services in the Western Province greatly inconvenienced the traveling public, particularly the low-income earners, whose travel, under normal circumstances, is facilitated by low-cost railway services (Kumarage, 2007). Even though bus transport services were permitted, they were inadequate to meet the demands of the travelers. Since private modes of transport were too expensive, the non-availability of train services severely constrained the mobility of low-income earners, thus causing a social equity issue. Besides, the use of alternative modes of motorized transport results in relatively high fuel consumption leading to additional fuel expenditure. This would have added extra pressure on the already constrained foreign exchange reserves of the country. Similarly, the relatively high levels of emissivity associated with other motorized transport modes, particularly the private modes, would have resulted in greater environmental pollution (European Environment Agency, 2021). These overarching implications of non-availability and curtailment of train services highlight the socio-economic and environmental services generally produced by the railway service.

The present research was an attempt to quantitatively examine the contributions made by the Sri Lanka Railway service toward promoting social, economic, and environmental equity in the country. The research, focused on the case of the Western Province in the immediate aftermath of COVID-19 lockdowns, yielding estimates that could possibly be extrapolated to other urban centres of Sri Lanka served by the railway network as well.

Background of the problem and objectives

Sri Lanka Railway (SLR) is the operator of train services in Sri Lanka, functioning as a Government Department. It is an integral part of the public transport service in the country. Though its passenger and freight transport market shares have gradually dwindled over the years,² its contribution to the economic and social wellbeing of the nation is significant. Interruptions or suspension of train services generally result in a significant increase in traffic congestion, especially in urban cities as well as in arterial road corridors in the country. This fact was evident when the country opened up on 1st October 2021 without resuming train services in the Western Province. The arterial roads to Colombo from all directions parallel to rail corridors, were heavily congested on Monday, 4th October 2021, and thereafter. Consequently, the country had to bear significant direct and indirect economic costs.

Economic and social services produced by the railway operations have been subject to discussion in literature [(Chen & Whalley, 2012), (Lalive, Luechinger, & Schmutzler, 2013), (Gunaruwan & Sannasooriya, 2018), (Chwiałkowski & Zydron, 2022)]. Yet, the value of such services appears to have been frequently under-estimated by policy makers. This could be one reason why the authorities did not give sufficient attention to recommencing the train services when the country moved out of COVID-19 lockdowns.

This research was thus conducted to assess the direct and indirect costs of opening the economy without resuming train services, focusing on the Western Province of Sri Lanka. Issues related to social equity, fuel costs, and carbon emission implications of this decision were examined in detail. Many other aspects, such as the value of time savings and ineffective utilization of road space, though recognized as important and discussed, were not quantitatively assessed in this research.

Literature review

Responding to the demand to enhance mobility, transport planners in the early twentieth century focused mainly on increasing the speed of travel using private automobiles (Yeganeh, Hall, & Pearce, 2018). However, infrastructure was inadequate to keep up with the increase in travel demand. Upgrading and developing motorized transport infrastructure incurred huge initial capital costs. Furthermore, the environmental pollution caused by such transportation and the income inequities made the goal of travel time reduction through private motorized vehicles less achievable or desirable. Therefore, the private modes of transport only made a limited contribution to improving the mobility levels of the general public (Shen, 1998).

In recent decades, various crises, including health and terrorism-related issues, have compelled people to make significant changes in their mobility behaviors and transport mode choices. This has caused sudden changes in the demand for different modes of transport (IEA, 2020). Sri Lanka experienced such shifts in the post-Easter Sunday attacks period in 2019, and during and after the COVID-19 related lockdown. The contributions made to the society, the economy, and the environment by public transportation became

acutely felt during such periods as the increased use of private vehicles resulted in increased traffic congestion on roads leading to excessive travel times and exhaust emissions.

The impact of the absence of rail transportation during the early post-lockdown period could be cited as a classic example of this effect. Because train services had not resumed, people had no option other than to use road-based transport modes, thereby causing heavy traffic on roads. As a result, motorists had to spend more time on roads immediately after travel restrictions were removed. This explains why rail transport is considered as the alternative mode that could most effectively mitigate road congestion and increase road travel speeds, yielding significant national economic benefits: an estimate made for Latin American cities revealed that a consequent travel speed increase of cars by 1 kmph, and of buses by 0.5 kmph, could potentially give rise to 0.1% increase of Gross Domestic Product [Thomsen, B (2002), as cited in (Bull, 2003)].

The existence and the development of public transport services, particularly rail transportation, and transit-oriented development leading to reduced per-capita vehicular travel, have been found in literature as directly contributing to reduce transport-related environmental impacts (Littman, 2020). Passenger transport has been found responsible for around 40% of the final demand for petroleum and 15% of global energy-related carbon emissions (IEA, 2020). Almost 20% of the total CO₂ emissions in smaller and medium-sized cities in developing countries, for instance, are generated by motorized road traffic (Pojani & Stead, 2015). The main source of ambient air pollution in Sri Lanka is vehicular emissions, which contributes to over 60% of total emissions in Colombo (Yatagma, Wickramasinghe, & Shanthikumar, 2010). Thus, it is clear that any increased use of private vehicles during the post-lockdown period, caused due to the absence of rail transportation, would have resulted in significant environmental costs.

The impact of transportation on resource economics also is very significant. The transport sector consumes 30% of worldwide energy, 95% of which is supported by liquid fuels (Panday & Bansal, 2015). Therefore, any crisis-induced changes to patterns of people's travel will have significant implications on the global energy market.

The curtailment of train services in the immediate aftermath of the COVID-19-related lockdown period has to be looked at in this context. In addition to the transport behavioral changes of people during the pandemic, the Government-imposed restrictions on train services and the apparent continued inability of the Sri Lanka Railway to provide a properly scheduled train service appear to have caused, and is still causing, significant socio-economic and environmental ill-effects. This aspect of crisis-hit curtailment of railway services, and its impacts on the society, economy, and environment, have not yet been adequately explored. This article aims to bridge this gap in the literature.

Materials and methods

The research focused on three implications of curtailing railway services, namely equity aspects of mobility, fuel economics, and carbon emissions, to quantitatively assess the value of socio-economic services rendered by the railway system. The Western Provincial railway network was considered as a case study. But, passenger-kilometer based costs

derived through this analysis reveal mode-specific differences, and thus, could be used for generalization. The periods prior to 2019 were considered for comparative analysis, because the periods there-onwards could not be considered “normal” for estimating benefit valuations.³

Comparative analysis of costs and externality implications against alternative modes was adopted as the research methodology. Fare levels and their differences were chosen to mirror equity aspects, while relative fuel consumption intensities and emissivity factors were used to estimate the economic and environmental impacts of alternative modes of mobility.

The research analyzed monthly train ridership data prior to 2019, using the Origin-Destination Matrix (Sri Lanka Railway, n.d.). The comparative impact of alternative modes of transport used by those travelers, who hitherto used railway services in the Western Province, were examined under different scenarios of possible changes in mobility patterns. This methodology was adopted because the exact estimates of the decline of passenger demand due to home-based working or other means of mobility suppression, and the data pertaining to use of alternative modes of transport such as buses or private vehicles, were not available. Comparison of differences, presented in tabular and graphical forms, and narrative examination, were adopted as methods of analysis.

Required information and data were obtained from reports published by the Sri Lanka Railway, National Transport Commission, Sri Lanka Transport Board, Central Bank of Sri Lanka, and Department of Census and Statistics (DCS). Technical coefficients estimated by the authors using data obtained from those reports as well as from other published sources were also used. The research focused on railway services in the Western Province. However, the outcomes were mapped on to per-train kilometer-based estimations for the purpose of possible generalization of the results to the overall railway service.

Analysis, results, and discussion

The research departed from the observation that there was unusually severe traffic on sub-urban motorways towards Colombo city on the first Monday after opening the country on 1st October 2021 with no train services in operation on all lines in the sub-urban railway network. A significantly high number of small private vehicles were on the roads, an obvious outcome whenever one or more competing public transport modes are not in operation. The resulting vehicular traffic and the extended travel times the passengers had to spend in both public and private transport vehicles were noteworthy, thus hinting at the choking effect of the absence of railway services on Colombo’s urban mobility.

The embargo imposed on train services persisted for over 20 days, while a limited service was permitted for season ticket holders during the next 10 days. The railway services opened for ordinary railway passengers only on 1st November 2021. The stated reason for the restriction was the possible spread of COVID-19 resulting from the failure to control the over-crowding of trains. Thus, almost one month of passenger mobility in the Western Province was without an effective train service in operation.

As the first step, the study examined the data on railway passenger trips in the Western Province⁴. 7.6 million passenger trips had started and ended within the provincial boundaries during March 2016 (Sri Lanka Railway, n.d.), with an average of 23 kilometers of distance traveled per trip⁵. Even if one assumes that there has been no growth in train travel since then, this would imply that more than 176 million passenger-kilometres would be transported monthly by the railway system in the Western Province⁶. Estimating for 22 working days a month, this amounts to 0.35 million daily passenger trips, giving rise to 8 million passenger-kilometers of daily demand.

It is understood that the mobility demand itself may have reduced during October 2021 for various reasons, including the absence of school traffic, and offices functioning with less than the total effective cadres. Yet, those passengers who opted to travel within the province, who otherwise would have taken the train, had to resort to alternative transport modes because of the absence of railway services. They would have had to use bus services (which were also significantly curtailed due to COVID-19 restrictions) or else, private transport modes such as vans, cars, three-wheelers or motorcycles. All such modes are comparatively financially expensive, more fuel intensive per passenger-kilometer (or even per seat-kilometer) transported, and more emission intensive than railway transport.

Contributions towards social equity

The railway is the least financially costly mode of travel for passengers, except, possibly, push-cycling and walking. However, these cannot be considered practical alternatives except for relatively shorter travel distances. In this context, deprivation of any passenger's mobility needs due to the unavailability of the low-cost railway mode and unaffordability of alternative modes of transport is an equity concern.

The analysis in Table 1, which summarizes the comparative costs per passenger-km for an average 20 km travel one-way using the ordinary railway, bus, and hired three-wheeler, in October 2021, indicates that the fare levels of railway mode were substantially lower compared to those of its closest competitor, the public bus service. The financial benefit is even more evident when the season ticket discount for the regular commuters is taken into consideration. Therefore, the largest financial burden of not having railway services would be on the economically and socially vulnerable segments of the society, such as low-income groups and school children. Their travel costs per month would go up by approximately 140% and 500%, respectively, if they were to opt for bus travel in the absence of train services. Even if it is assumed that 10% of the train travelers fall into this socio-economically vulnerable segment, their mobility requirements would amount to approximately 0.76 million passenger trips per month. Their aggregate additional financial burden on mobility would be approximately Rs 16 Mn per month, if they were to pay for the supplementary cost to ensure mobility by bus, assuming an average daily travel distance of 20 km one-way.

**Table 1: Comparative fare levels of alternative urban public transport modes
(For 20 Km distance – one way) Rs per passenger-km**

	Railway (3rd Class travel)	Public Bus (Ordinary buses)
Full fare – one way (Rs/trip) (Oct 2021)	25.00	53.00
One-way average fare per km	1.32	2.65
The season ticket for private individuals (For 22 round trips per month)	0.72	1.72
The season ticket for government sector (For 22 round trips per month)	0.36	
The season ticket for adult school children (For 22 round trips per month)	0.18	1.08

Notes:

- (i) Fare levels considered are those prevailed in October 2021
- (ii) Adult Season ticket discount in Sri Lanka Transport Board (SLTB) is 65% of the full-fare charge for 22 days, while the students are charged 30% for 30 days
- (iii) In SLR, 40% of the charge applicable for 60 one-way trips is the season ticket fare for private individuals, while 20% and 10% respectively are charged from Government employees and adult school children.

Sources: Authors' estimations using data from SLR, SLTB, and National Transport Commission (NTC)

It is in this context that the equity implications arise. Being a developing country, train travelers in Sri Lanka are considered the poorest among the daily commuters in the urban society. Unlike those who live in relatively wealthy countries and have access to remote working facilities or alternative private means of transport,⁸ these low-income earning urban train travelers in Sri Lanka may not have the required purchasing power to afford such alternative travel modes when and where significant changes to transport patterns occur as a result of transport disruptions or perceived risks of traveling (IEA, 2020). There may be passengers who would struggle to pay the higher fares to travel even in the cheapest alternative, the bus, and the possibility of some of them foregoing fulfillment of their mobility needs cannot be excluded. The absence of train services, when the other transport modes were permitted, would amount to a direct discrimination against those financially under-privileged train travellers.

Therefore, it is evident that the suppression of train services in the Western Province for several weeks in October 2021 had negative equity implications on society. When the analysis is mapped onto the entire railway network of the country beyond the Western Province, it reflects the contribution that the train services make toward social equity in Sri Lanka. Though not formally recognized, its importance is implicit in the Government's reluctance to increase railway fares despite the increase in bus fares and fuel price

escalations. Yet, it is not clear why this equity consideration was implicitly ignored when the country opened after COVID-19 induced lockdowns without the resumption of train services.

Fuel consumption economics

Focusing on the second dimension of economic costs, the research attempted to analyze the comparative consumption of fuel among alternative modes of travel. A scenario-based estimation, as indicated below, was carried out as no data were available on the relative shares of alternative modes of transport chosen by passengers in the absence of railway services:

Scenario A: All train travelers in the Western Province would shift to public buses in the absence of train services.

Scenario B: All train travelers in the Western Province would shift to private motorcycles in the absence of train services.

Neither of these two Scenarios would be realistic in their literal sense; but, would be useful in two ways. Firstly, these estimates would establish a range of the extra foreign exchange burden on fuel imports that would be necessitated owing to the unavailability of train services. Secondly, the estimates reflect the scale of fuel economics the country could secure by achieving a strategic shift of passengers towards rail transport away from the compared modal alternatives.

Table 2 summarises the estimations of comparative fuel consumption intensities corresponding to the scenarios considered.

Table 2: Fuel consumption requirement for transporting Western Province's rail passenger load

Western Province Railway Passenger Transport Demand	0.345 Mn Passenger Trips per day	Average Distance of 23 km per trip	7.99 Million Passenger km Per day
	Train	Bus (Scenario-A)	Motorcycle (Scenario-B)
Load Factor (passengers/vehicle)	1000	40	1.5
Vehicle km to meet the demand	7,945 Train km per day	198,600 Bus km per day	5.29 Mn Mobyke km per day
Fuel intensity per vehicle km	3 liters/km	0.33 l/km	0.025 l/km
Fuel consumption demand (liters/day)	23,800	65,550	132,400
Additional fuel per month compared to train	-	0.92 Mn liters per month	2.39 Mn liters per month
Additional cost to the economy / month (at 0.70 USD/liter)	-	USD 0.64 Mn, or Rs 128 Mn	USD 1.67 Mn, or Rs 334 Mn

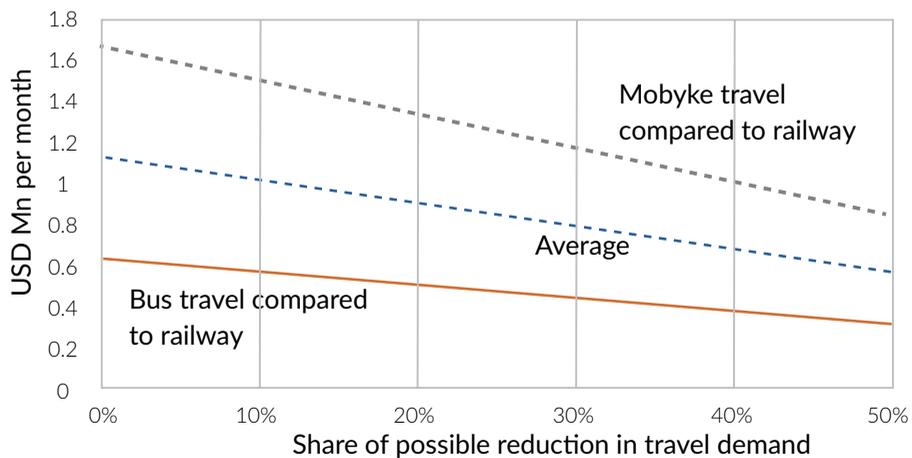
Source: Authors' estimates.

The results reveal that substantive additional fuel import costs would have to be incurred if the entire Western Provincial railway passenger demand per month, that is 176 million passenger-kilometers, were to be transported using alternative modes. Sri Lanka would have had to import additional 0.92 million liters of diesel in October 2021 if the monthly railway demand of the Western Province was met exclusively by bus service (Scenario-A). If the entire demand was met by motorcycles, the additional fuel consumption would have amounted to nearly 2.4 million liters (Scenario-B).

These estimates indicate that the country would be compelled to spend over USD 0.6 million a month (Rs 128 Mn) of additional fuel cost if the entire monthly railway passenger demand in the Western Province was to be met using the bus service. The corresponding additional economic cost of fuel would amount to over USD 1.6 Mn (Rs 330 million) if the substitution was to be from the motorcycle mode.

These results could be further examined, taking into account the possibility of reduction of the overall transport demand due to a number of consequential factors such as the absence of school traffic, work-from-home arrangements, and constraints on mobility due to unaffordability (as discussed before). The pattern of fuel cost implications in relation to the share of rail passenger demand so reduced could be worked out as depicted in Figure 1.

Figure 1: Range of additional fuel expenditure if traveled by alternative modes



Source: Authors' estimations

The above results reveal that Sri Lanka would have had to spent significantly higher amounts of foreign exchange on fuel imports because of the governmental decision not to operate trains when the country opened up after COVID-19 lockdowns in October 2021. In the Western Province alone, this extra cost would have ranged between USD 0.64 Mn if the entire railway passenger demand remained active and was transported by bus, and USD 0.32 Mn in the unlikely event of the active demand having been halved. If the same travel demand was transported by motorcycles, the corresponding additional expenditures would have been USD 1.67 Mn and USD 0.89 Million, respectively, for the month of October 2021.

The contribution of the railway service towards foreign exchange savings on fuel imports is evident through this analysis. The country could save approximately USD 0.6 Mn to USD 1.2 Mn a month (the Average scenario in Figure 1) if the railway services manage to transport passengers in the Western Province according to the mobility patterns that prevailed before the COVID-19 pandemic. This shows a substantial potential for national economic savings realizable through the train service. Expressing this potential in specific transport units, the country would secure economic benefits within the range of one-third a US cent to two-thirds a US cent per every passenger-kilometer transported by railway mode, just on the difference in fuel consumption economics.⁹

These results reflect the national economic contribution that the railway service generally makes by reducing fuel import intensity. For instance, every 1000 passenger-kilometers of transport demand met by railway (approximately by one train-kilometer), instead of bus service, would save 5.25 liters of diesel imports to the economy. The corresponding saving would be 13.7 liters of petrol if compared against the motorcycle mode as the alternative means of mobility. When mapped on to the national scale, these results indicate that the island-wide railway service, catering to the travel demand of 7.7 billion passenger-kilometers in 2018 (Central Bank of Sri Lanka, 2020), would have reduced fuel imports to the tune of 40 million liters of diesel (compared to bus transport) or 105 million liters of petrol (compared to motorcycle travel). This would have saved USD 28 Mn and USD 73 Mn of foreign exchange in that year, compared to the corresponding alternative modes of bus or motorcycle, respectively.

Moreover, it is important to perceive that, in the absence of train services, at least a smaller share of train travelers would resort to other private transport modes such as cars or vans, which have much higher fuel consumption intensities. The foreign exchange saving potential of railway service would reflect much higher levels if fuel consumption intensity of railway transportation is compared against those private four-wheeler transport modes.

Greenhouse gas emissivity

The railway mode is considered the most environmentally friendly motorized land transport mode (International Union of Railway, 2017). Even on diesel-powered traction, the railway is less fuel intensive per seat-kilometer, and thereby, less emission intensive than other motorized land transport modes. This aspect was examined in the present research as the third dimension of its analysis. An attempt was made to estimate the additional emission burden on the environment due to the non-availability of train operations in the Western Province when the country emerged out of COVID-19 related lockdowns.

The emissivity of CO₂ in fossil fuel combustion is approximately 2.4 Kg per liter of petrol, and 2.6 Kg per liter of diesel (Ecoscore, 2022). Thereby, the additional emission of greenhouse gases resulting from railway passengers in the Western Province switching to alternative modes would be as summarised in Table 3.

Table 3: Comparative carbon emission effect of alternative transport modes: Emission reduction effect of railway-based mobility in the Western Province

Rail passengers of WP, if transported by alternative mode	Bus	Motor Cycle
Additional fuel consumption (liters/day)	41,714	108,588
Additional CO ₂ emissions compared to rail travel	13.6 g/psgr km	32.03 g/psgr km
	108 MT/day	254 MT/day
Number of trees additionally needed for sequestration of the added CO ₂ emissions	1.4 Million	3.2 Million
Additional forest area needed for sequestration (at 240 trees/ac)	5,700 acres	13,400 acres

Sources: Authors' estimates using emissivity coefficients of fuel varieties (Ecoscore, 2022),

The analytical results depicted in the Table 3 reveal that over 100 Metric Tons of CO₂ would be additionally emitted into the atmosphere daily from the Western Province, if the passengers switched to public buses in the absence of trains. This additional CO₂ load would require nearly 1.4 million fully grown trees for its full sequestration (Arbor Day Foundation, n.d.). This would require growing an additional forest area of around 5700 acres. This green-house effect would be much higher if the passengers used motorcycles as the alternative mode of travel in the absence of railway services.

The above outcomes could be generalized using the travel unit specific ratios of parameters presented in Table 3. An additional Carbon Dioxide emissivity of over 13 grams per every passenger-km is involved in bus transportation as opposed to trains. Therefore, it could be estimated that the railway service has prevented over 100000 MT of CO₂ from being emitted to the atmosphere by transporting 7.7 billion passenger-kilometers in 2018 (Central Bank of Sri Lanka, 2020), instead of transporting the same by buses. This reduction of emissions would be nearly 2.5 times if compared against the motorcycle mode. In other words, if not for the train service in Sri Lanka, a significant amount of additional CO₂ would have been emitted to the atmosphere in 2018, the sequestration of which would have required between 4.8 Mn and 11.3 Mn of additional fully grown trees, depending on the share of alternative transportation provided by buses and motorcycles, respectively.

Other external effects

Non-availability of railway services in the Western Province would result in additional motor vehicles operating on roads. For instance, over 1000 additional buses would be required if the entire railway passengers were to be transported by buses. Alternatively, around 50000 additional motorcycles would come onto the roads, if all these train passengers opted to use their own private motorcycles. Needless to mention that this would severely constrain mobility on already congested roads in and around the

city of Colombo. The resultant inefficiency in fuel combustion, the additional emissivity of greenhouse gases, the waste of time in heavy traffic, and resultant stress on drivers possibly causing health and accident risks, could be substantial, even though not accounted for in this study.

Road space usage is another dimension that would call for consideration. Most of the highways in Sri Lanka are freeways. They are maintained at a heavy cost to public coffers, for which the poorest of the poor in the society also pay. The level of cost recovery of expressways through tolls also has to be examined. This is because any deficiency in recovering costs, including servicing of foreign loans, amounts to an implicit subsidy to rich motorists at the cost of the general public. Not all can afford a motor vehicle, though all of them, and their future generations, contribute towards maintaining such roads and settling corresponding public debts through payment of indirect taxes; a clear issue of intra and inter-generational equity. In such a context, inefficient usage of road space by private vehicles cannot be justified.

Less than four motorcycles with a maximum of 6 riders altogether would occupy, when in operation, almost the same road space as a bus carrying 40 passengers or more. In the case of three-wheelers or cars carrying less than two passengers on average per vehicle, two vehicles would require more road space than a 40-seater bus. This amounts to a wasteful usage of physical infrastructure. Moreover, road congestion compels the State to expand capacities or develop more roads at heavy capital expenditures financed, quite often, through foreign borrowings. This leads to long-term macroeconomic ill-effects including indebtedness, debt-servicing problems, balance of payment issues, as well as foreign political or economic interventions that may compromise even the political sovereignty of the nation.

In that respect, railway services in Sri Lanka provide an invaluable service towards social equity (both inter-generational and intra-generational equity), resource economics, and environmental sustenance, regardless of its financial performance.

Conclusions

The research examined the economic implications of opening the economy in October 2021 after COVID-19 related lockdowns, but with no railway service in operation in the Western Province. The outcomes of the analysis demonstrated that the economic and social impacts of the non-operation of trains in the Western Province during October 2021 have been severe. Though the study focused on the one month in the immediate aftermath of lifting lockdown, the findings reflect the significance of socio-economic and environmental benefits generally produced by the railway services, though not adequately recognised by the policy makers, professionals, and general public.

The fuel saving benefits of the train services in the Western Province, estimated in this research, amount to USD 3675 and USD 9566 per million passenger-km compared to the hypothetical scenario that the entire railway passenger demand of 176 Mn per month has to be met by bus and motorcycle transportation, respectively, in the absence of train services. This fuel saving, if applied to the totality of 7.7 billion passenger km transported

in the entire island by the railway mode in 2018, instead of the same demand being met by the passengers using their motorcycles, for instance, would be in excess of USD 70 million (or over Rs 14 billion) per year. This fuel saving is double the financial operating loss recorded by the Sri Lanka Railway during that year (Central Bank of Sri Lanka, 2020). Therefore, it is evident that Sri Lanka, an already indebted nation, would have to spend more foreign exchange to import fuel to meet the excessive demands arising from the inefficient combustion on roads, leading to widened resource gaps and further foreign borrowings, if not for her railway service in operation. Such an eventuality would exacerbate the nation's foreign debt crisis and over-burden future generations with an expanded debt stock. Therefore, it could be inferred that developing the railway system would promote the nation's economic sovereignty and its inter-generational equity.

The outcomes of the research also enabled the inference that the benefits produced by the train service are much greater than the saving on fuel, particularly when the contribution towards social equity and the reduction of CO₂ emission are factored in to the analysis. The additional CO₂ that would be emitted in the absence of railway services, would result in health issues including respiratory problems, particularly in "geographic basins" such as the sub-urbs of Kandy, unless adequate means of sequestration of such additional emissions could be provided. The results of the research thus pave the way toward the conclusion that neglecting the railway system would not only be economically costly but also could result in long-term social, economic, and environmental ill-effects. Therefore, it is recommended that the railway system in Sri Lanka should be improved, developed, and expanded..

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1. Train service cannot be considered "normalised" back to the pre-COVID levels even now, as visible through cancellations of trains and curtailment of operations owing to pandemic-related implications.
 2. The passenger transport market share was down to below 4% by 2018, and the freight transport market share was less than 1% (Jayaweera, n.d.)
 3. Terror attacks in April 2019 caused significant disturbances to normal travel patterns. Prior to the complete disappearance of its effects, the elections in November 2019 intervened, followed by the COVID-19 pandemic in March 2020.
 4. Ambepussa (in the Main Line), Aluthgama (in the Coast Line), Kochchikade (in the Puttalam Line), and Avissawella (in the Kelani Valley Line) were considered as boundaries of the Western Province
 5. Since there could be trips that originated at stations beyond the boundary but ended within, or trips that originated within the provincial boundary but ended outside, the actual train travel within the Province is bound to be more, and this therefore should be considered an under-estimation or a lower-bound of train ridership within the Western Province.
 6. This study used the Matrix applicable to March 2016 since the Sri Lanka Railway has not compiled recent Origin-Destination Matrices. The actual number of passenger trips and passenger kilometres in October 2021 are bound to be more.
 7. Three-wheeler para-transit, possibly being the next lowest cost alternative, was not taken into analysis given its very high charges of approximately Rs 25 per kilometre (PickMe, 2021).

8. Even in the developed countries such as the United States of America, some groups including women, young adults, black workers, and low-income earners, rely more on public transportation for commuting than others (Burrows, Burd, & McKenzie, 2021).
9. The average scenario of a monthly saving between USD 0.6 Mn and USD 1.2 Mn, for approximately 176 Million passenger kilometres a month, yields an average between 0.33 US cents and 0.66 US cents per passenger kilometre of fuel savings. This would be between 0.5 US cents to 1 US cent per passenger km, if the scenario of the motorcycle being the alternative mode is considered.

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