

# Analysis of Traffic Congestion Impact Based on Road User Perception: A Case Jalan Gajah Mada, Batam-Indonesia

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## ARTICLE INFO

## ABSTRACT

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*Traffic congestion is a worldwide problem caused by population growth, heavy traffic due to the mixing of public, regional, and local transit traffic, and insufficient road capacity to accommodate the amount of transportation. This research aims to determine the impact of traffic congestion on road users' perception of Gajah Mada Street (Pura Agung Amerta Bhuna - UIB) in Batam City. The methods used in this research are quantitative and qualitative. The data source used in this research is primary data. Primary data was obtained by distributing questionnaires to road users containing questions related to the impact of traffic congestion. Based on research that has been conducted, traffic congestion can have an effect on the economy, psychology, and productivity of road users.*

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## 1. Introduction

Traffic jams still occur in many cities around the world. Traffic jams are common in countries with large populations. Traffic jams have become a worldwide problem. It is usually caused by population growth and the need to reach activities in different parts of a city. In Southeast Asia, about 42% of its 245 million population lives in urban areas, and the ratio is predicted to increase to nearly 50% by 2025 [1]. Congestion is also caused by heavy traffic due to the mixing of public, regional, and local transit traffic. It is disruptive to the public and affects the country's economy. In addition, there are many reasons for the congestion, such as the capacity of the road being insufficient to accommodate the amount of transportation, road repairs, and accidents [2].

In general, transportation is a means of accelerating the achievement of regional economic growth goals and connecting regions in the Republic of Indonesia. With the increase in motorized vehicles, traffic congestion has increased in major cities in Indonesia [2]. For example, DKI Jakarta has a high population density of 16,704 individuals per square kilometer. As a result, the capital city of Jakarta ranked 46th out of 404 cities on the list of cities with the most traffic. The degree of congestion varies wildly, depending on the population density, the capacities of the roads, and the alternative mode of transportation [3].

Batam City often faces congestion problems caused by traffic jams at several intersections or road sections. Traffic jams are caused by vehicles that want to make a U-turn. This usually happens at road intersections, causing long traffic jams and disrupting the convenience of motorists. In Batam City, the

The number of private cars and public transportation is increasing, and traffic congestion is becoming a severe problem [4]. The high number of transportation modes also has an additional impact on the number of road users, which indirectly causes congestion. One of them is characteristic of the road users, such as Gajah Mada Street in Batam City [5].

Gajah Mada Street is one of the arteries in Sekupang Subdistrict, Batam City. Gajah Mada Street is commonly used to commute to work and school. Traffic on Gajah Mada Street in Batam City is observed to be quite heavy and crowded. Because of the traffic density in many places, Gajah Mada Street is one of the most common congestion points experienced by everyone, especially students and lecturers who want to go to the Batam International University campus. This road is very congested [6]. Motorists use this road to work and school [6].

The area analyzed in this study was Elephant Mada Street (UIB) in Batam City. Traffic is quite heavy during working hours because many people use this road. Traffic congestion on these roads can cause problems for everyone, especially students and lecturers who drive to campus. The study aims to examine how the impact of congestion on the perception of road users on Gajah Mada Road (Pura Agung Amerta Bhuana - UIB) in Batam City is aware of traffic congestion. The results of this research will be used to determine the impact caused by traffic jams on the Gajah Mada Road (Pura Agung Amerta Bhuana - UIB).

## 2. Literature Review

### 2.1 Roads

Roads are a fundamental mode of transportation worldwide, so they must be maintained in good physical condition. Roads, highways, or right of way include road surfaces, sidewalks, drainage, and all related road facilities such as traffic signs, lighting, and others (Nainggolan et al., 2018). As traffic infrastructure, roads must meet a good level of qualification to provide safety and comfort for road users [8]. Transportation plays an essential role in developing the social and economic aspects of countries in the world. With good transportation, a country or region can achieve maximum utilization of natural resources and maximum productivity of society [4].

Roads are the central infrastructure that supports land transportation. According to their functions, roads are categorized into four: arterial roads, collector roads, local roads, and environment roads. Arterial roads are lanes that carry high traffic. Its mission is to divert traffic at the level of service from collector roads to highways and freeways and between city centers. Collector roads are built to serve and connect cities between regional and local activity centers or small-scale areas and regional shipping ports [9].

Road planning should pay careful attention to rainwater runoff. The pavement layer is easily damaged by standing water due to the nature of the asphalt mixture. This condition is caused by asphalt's properties that are not too strong against water immersion [10]. If the capacity of a road exceeds the volume of a road, it will cause congestion on the road. An increased traffic volume will lead to a change in traffic behavior [11]. There is no doubt that vehicle growth is rising. This impacts the cargo's number and capacity being transported, causing congestion on the road [12]. Since the road volume exceeds the road capacity, it causes congestion [13].

The greater the number of vehicles traveling on the road, the higher the potential for congestion. Roads must also be balanced with the adequacy and availability of transportation infrastructure and facilities

and good transportation management. This is to prevent traffic problems, namely congestion [14]. A road section is said to be congested if the traffic flow through the observed road section exceeds the designed capacities of the road, which results in a free velocity on that section of the road. The result is that the free rate of the road section is close to 0 km/h or even 0 km/h, which results in congestion [15].

## 2.2 The Traffic Management

Traffic management is maximizing the effectiveness of existing infrastructure to ensure safe traffic operations. It aims to ensure passengers' and goods' safe, orderly, and efficient movement [16]. Transportation management optimizes the existing infrastructure's efficiency to provide safe and reliable traffic operations. Traffic management aims to reduce the number of conflicts, ensure safe, orderly, and efficient passenger transportation, and reduce vehicle traffic congestion to smooth the vehicle movement system. Strategies in traffic management include priority management, capacity management, and demand management [17].

Traffic management aims to improve transportation efficiency to be far-reaching and can be implemented by directing traffic. This improves roads so the traffic system can operate optimally [9]. Based on the need to control traffic movement to achieve efficiency, safety, and comfort for road users. Intersections are one of the road networks that need attention because most traffic problems are at meetings. Of course, the goal is to produce more quality work for traffic flow [14].

The construction/development of an attractive activity center will generate traffic at a specific location on the roadside and will affect the surrounding traffic. The commemoration of holidays also affects the volume of traffic crossing the road [17]. Traffic management as an alternative to reorganizing or rearranging the road section. It aims to optimize the convenience and efficiency of infrastructure in traffic by using high-efficiency road sections to smooth the traffic flow movement system and provide convenience for public transportation using road space for the movement system [3].

Road traffic problems are complex issues in the world of urban transportation. Along with population growth and community dynamics, traffic jams often occur in big cities. They are solving traffic problems caused by many factors that become triggers. Traffic problems such as congestion also cause impacts felt by road users. However, with traffic planning and management that is well coordinated, fast, and accurate by the government, current traffic problems can be resolved and help reduce existing traffic problems [18].

## 2.3 Road User Comfort

Comfort is everything that shows suitability and harmony with the users of a room. Comfort in traffic significantly affects road user satisfaction. Road users use the road for traffic, using vehicles and people on foot [19]. One of the functions of the road is as a link between one area to another. Therefore, if congestion occurs quite often on a road section, then this reduces the comfort level of road users passing the road [20].

Various kinds of transportation pass through the road, from private and public vehicles to pedestrians. Almost all people in a region have personal vehicles. This is due to population growth that has a good economy or a stable income level [20]. If a city is large, it is not uncommon to find congestion on the highway. Congestion during peak hours is caused by multiple transports passing on the road [5].

A city or region that experiences an increase in the number of private vehicles, public vehicles, and infrastructure that often causes congestion [21]. Due to relatively high population growth, resulting in

density in an area. Congestion problems significantly hamper activities in good transportation. Congestion also has an impact on road users. Thus affecting the comfort and satisfaction of road users [22].

A road will experience congestion if the capacity exceeds the volume of a road. If so, the road will suffer traffic jams. Activity in significant cities often occurs during busy hours, such as in the morning and the afternoon, as many people cross the streets. This is very disturbing to comfort and has an impact on road users. The congestion causes the level of road user comfort to be disrupted, resulting in effects such as wasted time, shortened working and school hours, gasoline shortages, and loss of income [23].

### 3. Method

Data is one of the driving forces for scientific modeling and research compilation [24]. Research findings will be more precise when relevant data is used. Identification of the correct problems is the first step in a methodical scientific research process [25]. The problem observed is regarding road users' perceptions of the impact of traffic congestion. The research location is on Jalan Gajah Mada from Pura Agung Amerta Bhuana to the red light in front of Batam International University (UIB), Batam City, Riau Islands Province, about 1.1 km away.

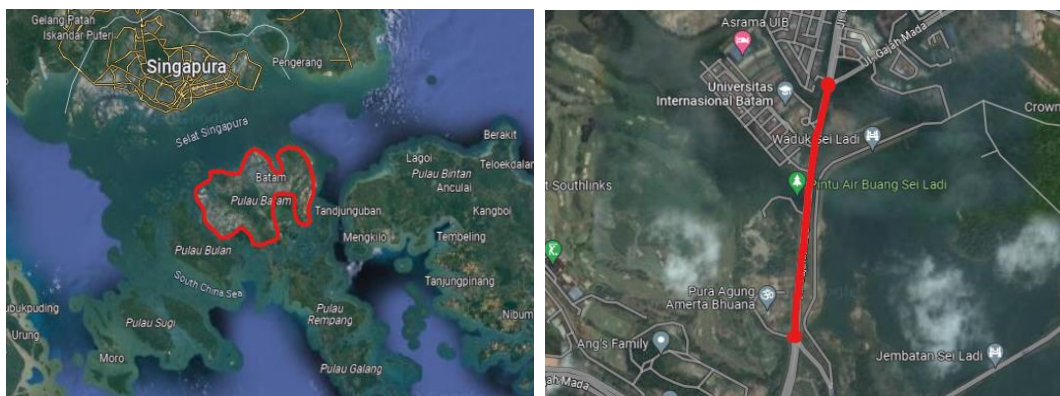


Figure 1 Research location on Jalan Gajah Mada, Batam City

The data used in this study is primary data. Primary data was obtained from the results of the dissemination of questionnaires to Batam International University students as road users in Jalan Gajah Mada, Kota Batam. The primary data collection techniques used in this research are disseminating questionnaires, observations, and documentation. The number of respondents who were sampled in this study was 50 respondents. In this research, the dissemination of questionnaires was carried out with target students of Batam International University, located right in front of Jalan Gajah Mada, Kota Batam, via social media on May 12, 2023.

The data analysis methods used in this study are quantitative and qualitative. Quantitative descriptive research is a method that aims to describe a condition that is ongoing at the time of the study and search for the causes of such symptoms using numbers, ranging from data collection, interpretation of the data, and the results [21]. Qualitative descriptive research is based on observations of data sources related to how to explain or describe research data through descriptions and explanations [26].

### 4. Result and Discussion

Road users in the Jalan Gajah Mada area, Batam City, were observed to be quite dense and crowded. This is because Jalan Gajah Mada is one of the connecting roads between Tiban and Batam Center areas.

Congestion occurs during peak hours, such as in the morning and evening. In the morning, residents of the Tiban area have to do activities such as going to work, school, the market, and so on towards Batam Center. This requires them to cross Jalan Gadjah Mada, so the flow on Jalan Gadjah Mada becomes congested.

In the afternoon, the traffic jam on Jalan Gadjah Mada was quite heavy. This is due to the reverse flow from Batam Center to Tiban. Residents returning from work will cross Jalan Gadjah Mada to return home to the Tiban area. In the afternoon, many students of Batam International University want to go to campus to study. This also causes a long traffic jam on Jalan Gadjah Mada. The congestion has several impacts on road users on Jalan Gadjah Mada. Congestion very often occurs during peak hours on Jalan Gadjah Mada because so many vehicles travel that exceed the road's capacity.



Figure 2 Morning and Afternoon Traffic Congestion on Jalan Gadjah Mada

#### 4.1 Characteristics of Respondents

##### 4.1.1 Characteristics of Respondents Based on Age and Gender

After conducting a research survey using an online questionnaire. There were 50 respondents who responded to the survey. Several variables derived from the data can be used to measure the impact caused by traffic congestion in Jalan Gadjah Mada, Batam City. Some characteristics of the respondents are described below.

Table 1. Characteristics of Respondents Based on Age and Gender

| Age   | Amount (Person) | Gender |        |
|-------|-----------------|--------|--------|
|       |                 | Male   | Female |
| 17-20 | 44              | 15     | 29     |
| 21-25 | 3               | 1      | 2      |
| 26-30 | 3               | 1      | 2      |
| Total |                 | 50     |        |

In the table above, it can be seen that the age-related frequency of respondents who use it feels the impact of traffic congestion. Of the 50 respondents, 44 were aged 17-20, 3 were aged 21-25, and 3 were aged 26-30. So, most who feel the impact of congestion on Jalan Gadjah Mada are 17-20 years old.

##### 4.1.2 Characteristics of Respondents Based on Occupation

Table 2. Characteristics of Respondents Based on Occupation

| Work      | Amount (Person) |
|-----------|-----------------|
| Student   | 43              |
| Employees | 4               |

| Work         | Amount (Person) |
|--------------|-----------------|
| Marketing    | 2               |
| Unemployed   | 1               |
| <b>Total</b> | <b>50</b>       |

From the table above, it can be seen that the frequency of respondent characteristics is based on occupation. 43 respondents are students of Batam International University, 4 respondents are private employees, 2 work in marketing, and 1 is not working. So it can be concluded that more Batam International University students feel the impact of traffic congestion on Jalan Gadjah Mada, Batam City.

#### 4.2 Analysis of the Impact of Congestion on the Economy of Road Users

According to the findings of a survey with 50 participants in Batam City's Jalan Gadjah Mada (Pura Agung Amerta Bhuana-UIB), traffic congestion is an awful scenario that affects the livelihood of those who utilize the roads. Each respondent experiences traffic congestion differently. The following table shows how traffic congestion affects road users' economies based on the type of work:

Table 3. Road User's Perception of the Impact of Congestion by Type of Occupation

| Impacts                                  | Student | Employee | Marketing | Unemployed | Total |
|--|---------|----------|-----------|------------|-------|
| Time-consuming                           | 42      | 4        | 2         | 1          | 49    |
| Reduced income                           | 24      | 3        | 1         | 1          | 29    |
| Spending the cost (wasteful of gasoline) | 36      | 2        | 2         | 1          | 41    |

The results showed that most of the 49 respondents agreed that congestion drains road users' time and, at the same time, feel the impact in terms of the economy. A total of 29 respondents chose to agree that congestion also causes reduced income. And 41 respondents decided that congestion can cost money, such as wasteful gasoline. The loss of time is an impact that must be borne by road users, even though the lost time can be used for other activities that can bring benefits, both in terms of the economy for road users themselves.

##### 4.2.1 Analysis of Traffic Jam Frequency and Traffic Jam Duration to Calculate Congestion

Table 4. Analysis of Traffic Jam Frequency and Traffic Jam Duration

| How long do you usually get stuck in traffic? | Do you often get stuck in traffic? |          |           |           |          | Total     |
|---|------------------------------------|----------|-----------|-----------|----------|-----------|
|   | Often                              | Always   | Sometimes | Rarely    | Never    |           |
| 5 minutes                                     | 5                                  | 0        | 0         | 3         | 0        | 8         |
| 10 minutes                                    | 13                                 | 2        | 0         | 9         | 0        | 24        |
| 15 minutes                                    | 9                                  | 0        | 1         | 1         | 0        | 11        |
| > 15 minutes                                  | 7                                  | 0        | 0         | 0         | 0        | 7         |
| <b>Total</b>                                  | <b>34</b>                          | <b>2</b> | <b>1</b>  | <b>13</b> | <b>0</b> | <b>50</b> |

Based on the results of research conducted on Jalan Gadjah Mada (Pura Agung Amerta Bhuana-UIB), which is approximately 1.1 km away, most respondents who stated the level and length of time stuck in traffic jams were 24 respondents, namely for 10 minutes each traffic jam. In addition, it can be concluded that traffic jams take up a lot of time for motorists on Jalan Gadjah Mada (Pura Agung Amerta Bhuana-UIB), Batam City.

### 4.3 Analysis of the Impact of Traffic Congestion on the Psychology of Road Users

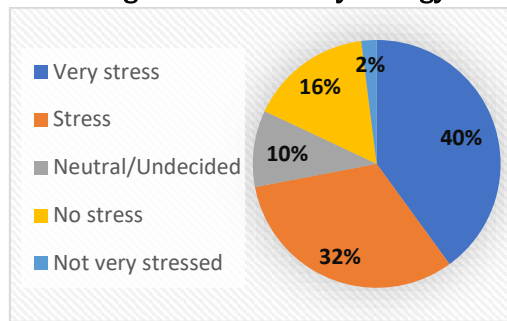


Figure 3 Impact of traffic congestion on stress levels

Based on the diagram shows how the congestion problem faced every day can affect a person's stress level. There were 40% of respondents who were very stressed, 32% of respondents were stressed, 10% chose neutral, 16% were not stressed, and 2% were very not stressed. The diagram shows that more respondents are very stressed about traffic congestion. However, some respondents chose neutral/undecided, and some also strongly disagreed that because of traffic problems it could cause stress.

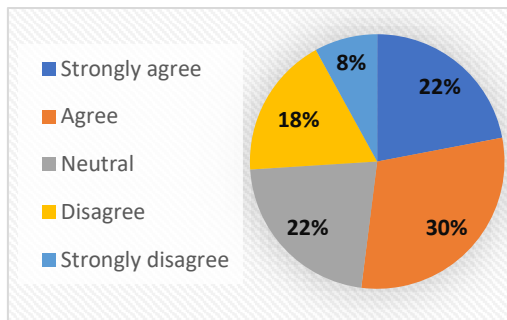


Figure 4 Impact of traffic congestion on concentration

The figure demonstrates how respondents may need help to focus when there is traffic. 30% of respondents selected strongly agree with the phrase, 22% selected agree and neutral, 18% chose to disagree, and 8% selected severely disagree. The graphic demonstrates that while a smaller percentage of respondents disagreed with the assertion that traffic jams made it harder for drivers to focus, most strongly agreed.

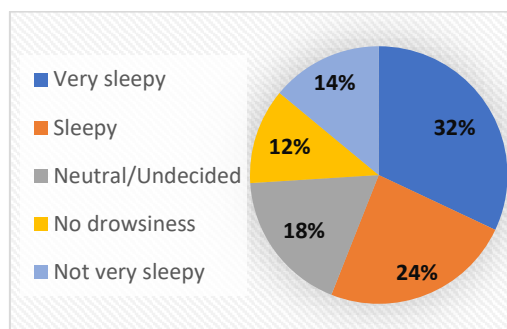


Figure 5 Impact of traffic congestion on drowsiness

The diagram illustrates that respondents can feel sleepy during traffic jams. There were 32% of respondents felt very sleepy, 24% of respondents felt sleepy, 18% of respondents chose neutral, 12% of respondents felt not tired, and 14% of respondents felt very not sleepy. The diagram shows that more respondents feel very sleepy when stuck in traffic jams, but some respondents choose neutral, and some respondents also feel very not sleepy when stuck in traffic jams.

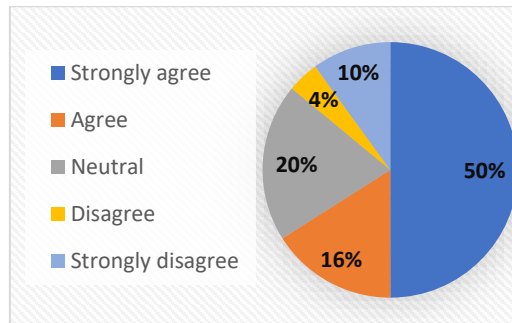


Figure 6 Impact of Traffic Congestion on Drivers' Mood Changes

According to the graph above, 50% of respondents strongly agree that being stuck in traffic causes mood swings, followed by 16% who opted to approve, 20% who selected neutral, 4% who chose disagree, and 10% who decided severely opposed. The graphic shows that while most respondents strongly agreed with the assertion that being stopped in traffic can impact one's attitude, some respondents chose neutral, and very few people strongly disagreed.

#### 4.4 Impact Analysis of Traffic Congestion on Road User Productivity

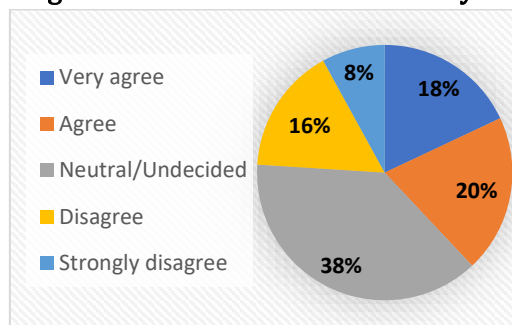


Figure 7 Impact of traffic congestion on health

The figure demonstrates how respondents' perceptions of their health may deteriorate due to traffic congestion. There were 38% of respondents selected neutral or undecided, 18% of respondents selected very agree, 20% of respondents selected agree, 16% of respondents selected disagree, and 8% of respondents selected strongly oppose. The graphic demonstrates that more respondents chose neutral or unsure when asked if they agreed or disagreed with the statement that traffic bottlenecks can harm respondents' health.

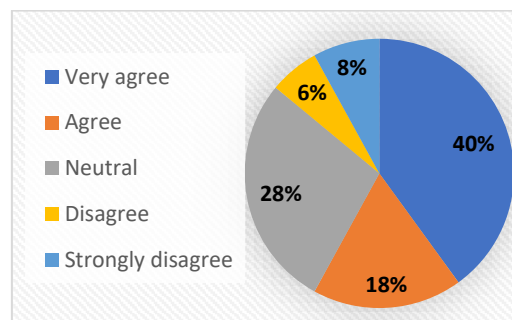


Figure 8 Impact of Traffic Congestion on Less Study/Work Hours

The figure demonstrates how reduced study or work hours among respondents may result from traffic congestion. 40% of respondents indicated they highly agreed with the statement, 18% indicated they agreed, 28% indicated neutral, 6% indicated disagreed, and 8% indicated strongly disagreed. The graphic demonstrates that a more significant percentage of respondents strongly agreed that traffic



congestion results in fewer hours of study or work. In contrast, a smaller percentage picked neutral or disagreed.

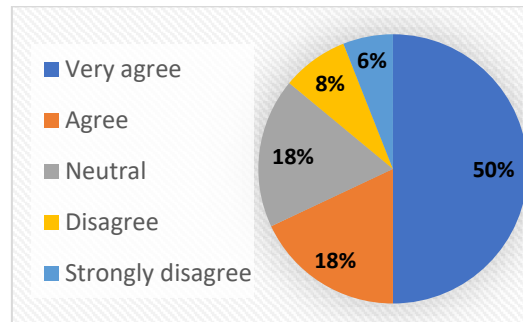


Figure 9 Impact of Traffic Congestion on Absenteeism at Study/Work Sites

The diagram above shows that there are 50% of respondents strongly agree that being stuck in traffic jams causes absence from the place of study/work, 18% of respondents chose to settle and neutral, 8% of respondents chose to disagree, and 6% of respondents chose to disagree strongly. The diagram illustrates that most respondents strongly agree that being stuck in traffic jams can cause absenteeism at the place of study/work. However, some respondents chose neutral, and also, a few respondents who chose firmly disagreed with the statement.

## 5. Conclusion

Congestion on Jalan Gajah Mada (Pura Agung Amerta Bhuna-UIB) results in road users experiencing economic losses. Traffic congestion can cause road users on Jalan Gajah Mada (Pura Agung Amerta Bhuna-UIB) to feel wasted time when stuck in traffic. When there is congestion, it also causes a waste of gasoline to the road users' income loss. Road users who pass on Jalan Gajah Mada (Pura Agung Amerta Bhuna-UIB) often experience traffic jams; the average time wasted is around  $\pm 10$  minutes per traffic jam. Traffic congestion impacts the psychology of road users when stuck in traffic. On Gajah Mada Road (Pura Agung Amerta Bhuna-UIB), the stress level of road users is 40%, there are 30% of road users find it difficult to concentrate when stuck in traffic, there are 32% of road users feel drowsy when exposed to traffic jams. Most users of Jalan Gajah Mada, 50%, agree that when stuck in traffic jams causes mood swings. Traffic jams also have an impact on the daily productivity of road users. When stuck in traffic, 38% of road users on Jalan Gajah Mada felt that traffic congestion did not affect their health. There are 40% of road users who think that their study/work time is reduced due to congestion. Moreover, most users of Jalan Gajah Mada, 50%, agree that delays in studying/work are greatly affected by traffic congestion.

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