

Research Article

Statistical Analysis on Consequences of Rising Fuel Prices on Citizens

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Abstract

This study investigates the broad economic, behavioral, and psychological impacts of rising fuel prices on urban residents in Vadodara, India. Primary data was collected from two key areas Fatehgunj and Tarsali using structured questionnaires to capture citizens' responses to the ongoing increase in fuel costs. The study had multiple objectives: to evaluate the direct consequences of rising fuel prices on household expenditure, assess the readiness of people to adopt alternative transportation methods, analyze fuel spending across different age groups and income levels, and understand how individuals are adjusting to manage this financial pressure. Furthermore, the study explores the impact of fuel inflation on mental health and seeks citizens' suggestions on how this issue might be addressed. An additional comparative objective was introduced to examine whether similar fuel pricing challenges are experienced in another developing country, specifically Kenya. A range of statistical tools were employed for data processing and analysis, including SPSS, R, Python, Microsoft Excel, and Power BI. These tools were used to conduct descriptive and inferential analysis, create data visualizations, and draw correlations between demographic variables and spending behaviors. The results reveal a significant shift in travel habits, increased financial stress among middle- and lower-income households, and growing public concern about long-term affordability. Many respondents reported cutting back on non-essential expenses, while others expressed willingness to switch to fuel-efficient vehicles or public transportation. These findings provide valuable insights for policymakers, economists, and urban planners aiming to develop effective strategies to ease the burden of rising fuel prices on the general public.

Keywords

Prices, Fuel, Citizens, Cost

1. Introduction

The ongoing rise in fuel prices has placed a significant burden on nearly every segment of society across the nation, making it increasingly difficult for individuals to manage their household budgets. Petrol is now being sold at over Rs 100 per litre throughout the country, while diesel prices have also reached historically high levels. Between March 22 and April 6, petrol and diesel prices increased by Rs 10 per litre marking

the steepest hike over a 16-day period since fuel prices were deregulated two decades ago [7]. This sharp escalation in fuel costs poses a direct challenge to the country's economic growth and future development plans. Indirectly, it drives up the cost of essential goods and services such as food items and public transport, affecting consumers on a daily basis [5, 2]. For private vehicle owners, the increased fuel expenses have

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made travel more costly, prompting them to adopt more frugal and cautious spending habits to cope with the financial pressure [1, 3]. As a result, people have started reducing their overall expenditures. Many private vehicle users have been compelled to reconsider their travel choices some opting to switch from cars to motorcycles or rely more on public transportation to manage their budgets more efficiently [6, 4]. Recent studies show that global crude oil prices have climbed to their highest levels in nearly ten years, largely due to the conflict between Russia and Ukraine, which threatens to disrupt global oil supply [8]. Experts had already anticipated a fuel price surge following the final phase of election polling. An increase in oil and gas prices generally leads to a higher consumer price index for petroleum products, impacting households directly. For producers, rising input and operational costs are often passed on to consumers in the form of more expensive goods and services [10]. This has a ripple effect on the wider economy, increasing production costs and, consequently, the final cost of goods. For households, rising domestic fuel prices affect real income both directly through higher costs for fuel and indirectly through inflated prices on goods and services that rely on petroleum in their production or delivery processes [9].

2. Objectives

To determine consequences of rising fuel prices on citizens.

To check whether people are ready to opt for an alternative method?

To identify, by age group and monthly income, how much people spend on fuel each month.

To identify how will people overcome this situation.

To know how much the rising fuel prices affecting people's monthly expenditure.

To gather public opinion on potential solutions to this problem.

To determine whether there is a link between in rising fuel prices and people's mental health.

To determine whether India and Kenya face similar challenges related to fuel pricing.

3. Pilot Study

For more sample size determination I conducted pilot study.

Question for pilot study;

How much people are concerned with rising fuel prices? (45 responses)

After calculating the responses of above questions and I got values of $P=0.83$ and $q=0.17$

Sample Size Determination

$$n = \frac{N z_{\alpha/2}^2 p q}{(N-1) \epsilon^2 p^2 + z_{\alpha/2}^2 p q}$$

N =Population of Fatehgunj and Tarsali (as per 2011 cen-

sus).

p =proportion of people who are concerning and facing impacts of rising fuel prices = 0.83.

q = proportion of people who are not concerning and facing impacts of rising fuel prices = 0.17.

ϵ = margin of error = 0.05.

$Z_{\alpha/2}^2$ = critical value of the normal distribution at required confidence level = 1.96.

By substituting all these values in the above formula, the sample size obtained is; $n=313$.

4. Sampling Techniques

Stratified sampling: Divided the population in 2 areas: Fatehgunj and Tarsali.

Using proportional Allocation; 95 samples has been collected from Fatehgunj and 218 samples have been collected from Tarsali.

5. Data Collection

Data collected from the primary source i.e. from two areas - Fatehgunj and Tarsali, also I collected some data from google form and some from hard copies of the questionnaire.

6. Data Visualization

Some factors of the data have been visualized using Power BI. Microsoft Power BI is a powerful data visualization tool and a very popular one. It is well known for its easy-to-use functionality for data preparation and data visualization.

7. Statistical Analysis on Personal Details

7.1. Age group

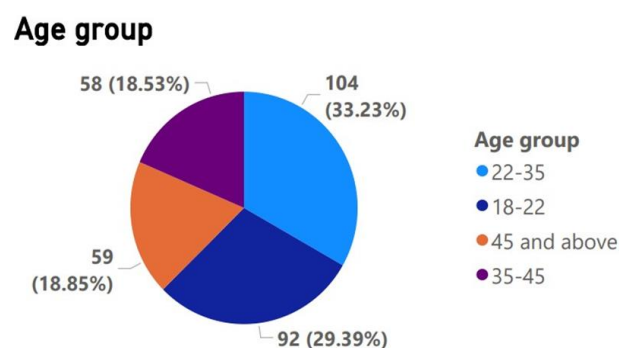


Figure 1. Age group.

Data of all age groups have been collected for the fair responses.

7.2. Gender

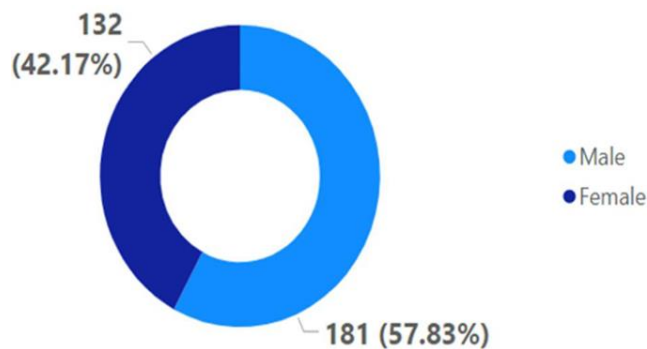


Figure 2. Gender.

In the data collection there are 58% males and 42% females.

7.3. Occupation

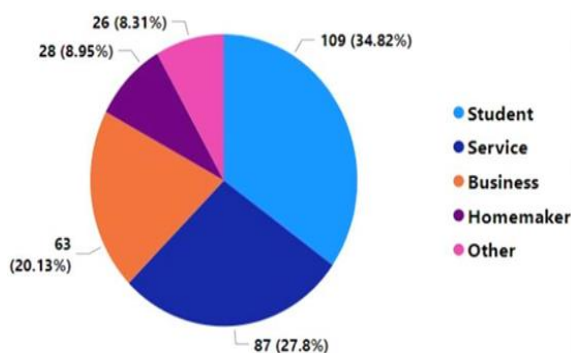


Figure 3. Occupation.

Approximately 35% students have provided their valuable response.

7.4. How Much Are You Concerned With the Continuous Hike in Fuel Price

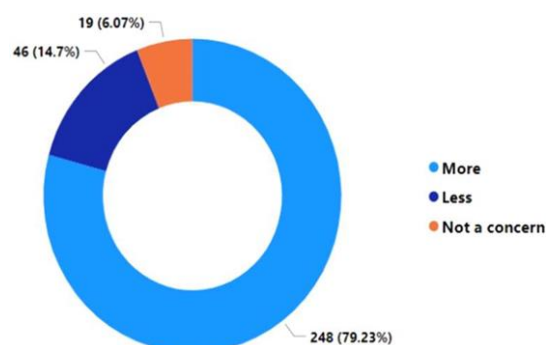


Figure 4. Perceived Concern Levels.

Approximately 80% people are more concerned with the continuous hike in fuel prices.

7.5. Which Type of Vehicle Do You Own

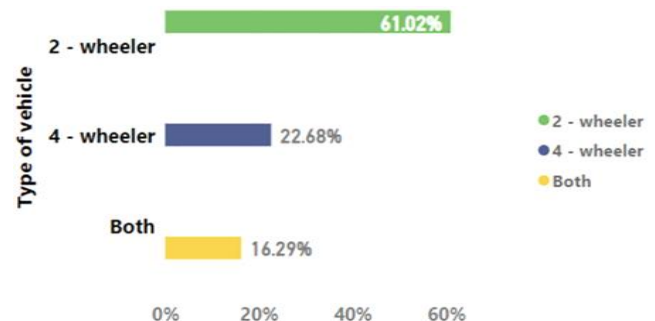


Figure 5. Type of vehicle.

Approximately 61% people are using two- wheeler, 23% people are using four- wheeler and 16% have both types of vehicles.

7.6. Type of Vehicle and Monthly Expenditure on Fuel

Age group	What is your monthly expenditure
18-22	1500 - 3000
22-35	1500 - 3000
35-45	1500 - 3000
45 and above	1500 - 3000
18-22	3000 - 4500
22-35	3000 - 4500
35-45	3000 - 4500
45 and above	3000 - 4500
18-22	less than 1500
22-35	less than 1500
35-45	less than 1500
45 and above	less than 1500
18-22	more than 4500
22-35	more than 4500
35-45	more than 4500
45 and above	more than 4500

Figure 6. Monthly Expenditure by Age Group.

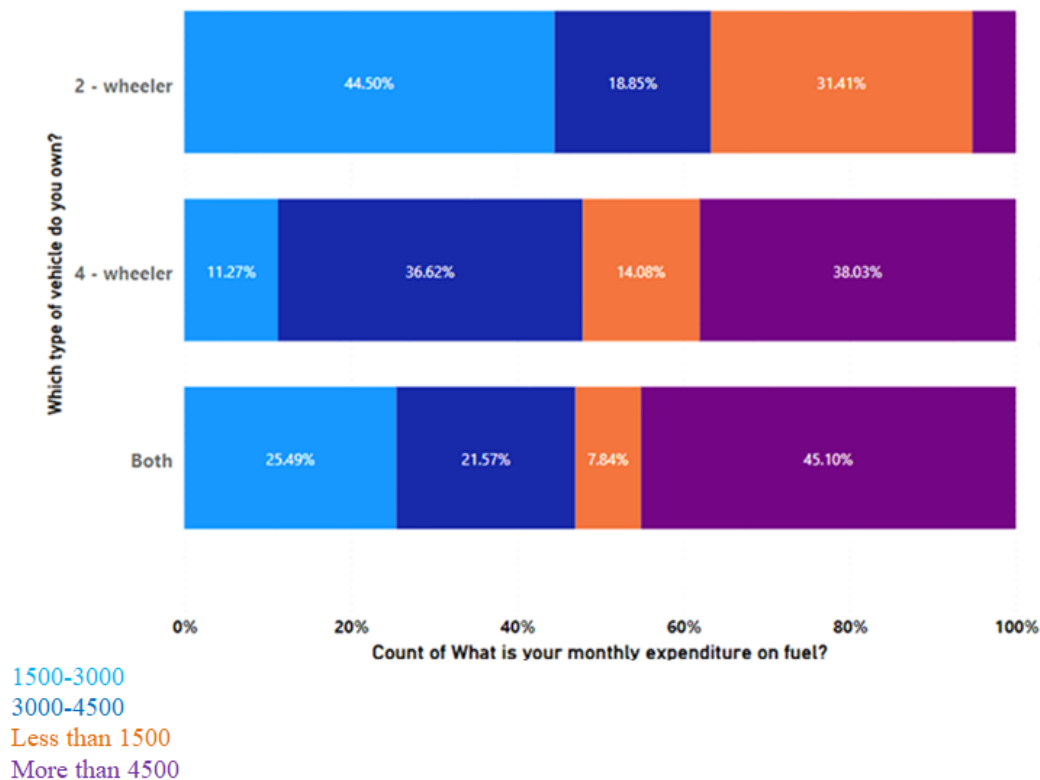


Figure 7. Monthly Fuel Expenditure by Vehicle Type. From the collection of data, I found that 61.02% people use 2-wheeler since it's a cheap means of transport compare to the response of 22.68% of people who use 4- wheeler.

When I compare the monthly expenditure on fuel consumed by 2- wheelers and 4-wheelers, I see that 44.50% of respondents spend 1500-3000 on 2-wheelers and 11.27%

spend 1500-3000 on 4-wheelers, as shown in the graph.

I conclude that a 2-wheeler is the most fuel-efficient mode of transportation when compare to a 4-wheeler.

7.7. Monthly Expenditure on Fuel of Different Age Groups

Age group	Count of age group	What's your monthly expenditure
18-22	31	1500-3000
18-22	12	3000-4500
18-22	38	Less than 1500
18-22	11	More than 4500
22-35	41	1500-3000
22-35	28	3000-4500
22-35	20	Less than 1500
22-35	15	More than 4500
35-45	16	1500-3000
35-45	18	3000-4500
35-45	5	Less than 1500
35-45	19	More than 4500
45 and above	18	1500-3000
45 and above	15	3000-4500
45 and above	11	Less than 1500
45 and above	15	More than 4500
Total	313	

Figure 8. Monthly Expenditure by Age Group.

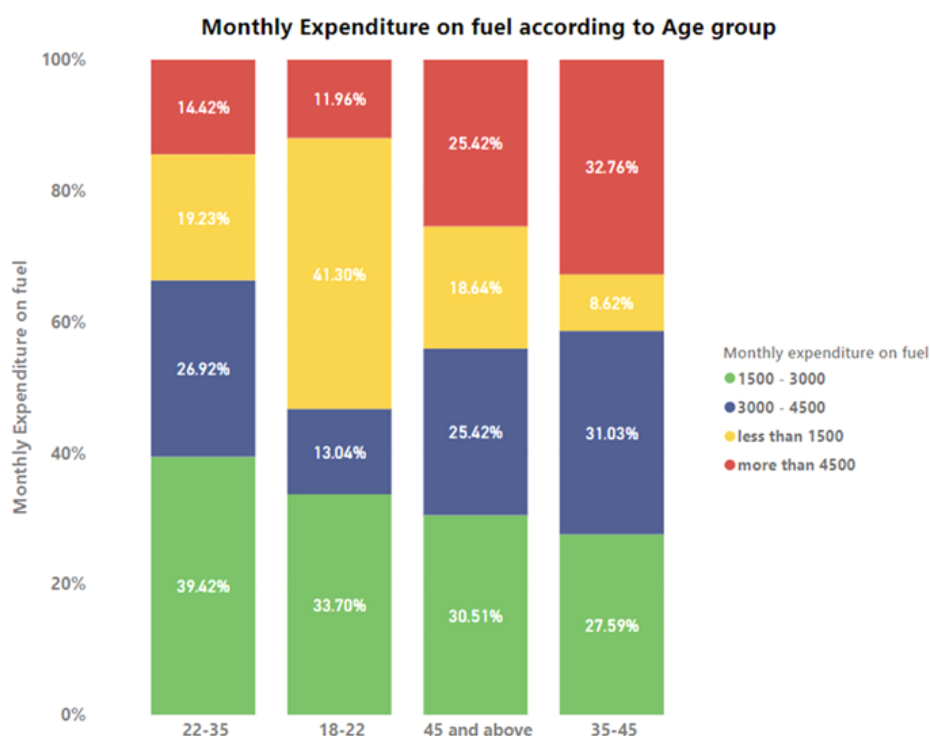


Figure 9. Monthly Expenditure on fuel according to Age group.

I see that from the response most people between age 22-35%, 39.42% responds that they spend 1500-3000 monthly expenditure on fuel, age group 18-22, 41.30% respondents spend less than 1500 monthly expenditure on fuel, age 45 and above I received 30.51% respondents said they spend 1500-3000 and age group 35-45 I received 32.76% respondents said they spend more than 4500.

From the survey, 42.49% responds that pursuing an alternative method will benefit them.

7.8. Alternate Methods

Do you agree that pursuing an alternative method will benefit you?

Agree

133

Disagree

21

Neutral

59

Strongly agree

94

Strongly Disagree

6

Which Alternate strategy do you believe you should adopt?

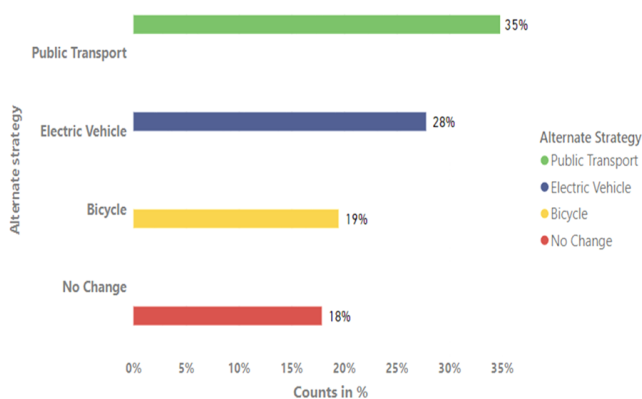


Figure 11. Alternate strategy to be adopt.

According to the graph, 35% of people agree on pursuing an alternative method of transport, public transport since it's cheaper as compared to private vehicle.

Figure 10. Agreement on the Benefits of Pursuing an Alternative Method.

7.9. Effects on Mental Health

Are you experiencing mental health concerns as a result of the daily fluctuation in fuel prices?

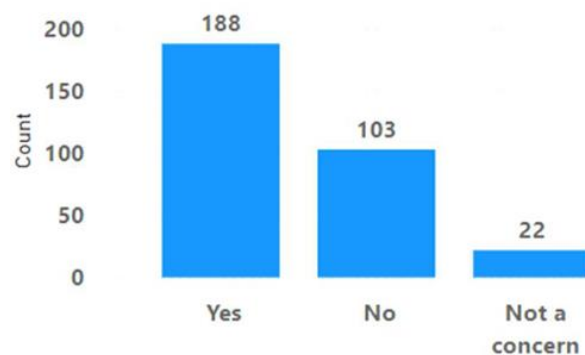


Figure 12. Mental Health Concerns as a Result of Fuel Price Fluctuations.

What is your reaction whenever you hear about rising fuel prices?

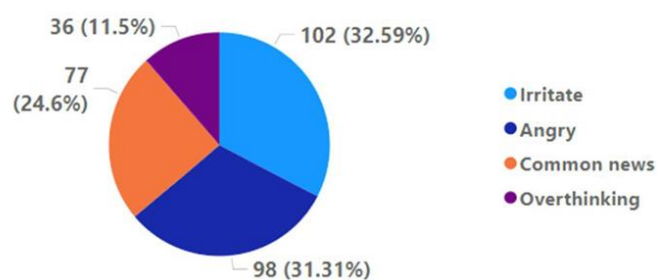


Figure 13. Reaction about the rising fuel prices.

Problems people are facing

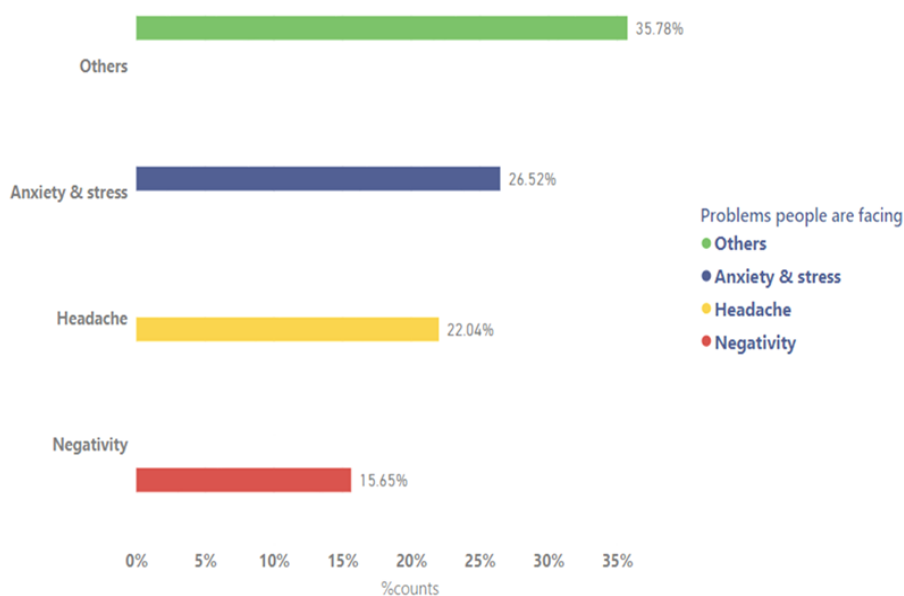


Figure 14. problems people are facing.

From the above graphs, I realized that most people are experiencing mental problems when fuel prices are increased since it interfere with their monthly budget as they have to spend more on fuel. 32.59% responds that when they realized about rising on fuel prices, they get irritated, 31.31% responds that they are angry, 24.6% that they just find it as common news and those who overthinks 11.5% responds. According to my survey I conclude that people face different problems since individual has different perspective about the rise of fuel price.

7.10. Which Category Is Suffering the Most

Lower class

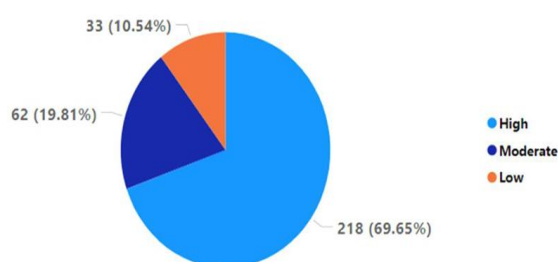


Figure 15. Lower Class Fuel Price Impact.

Middle class

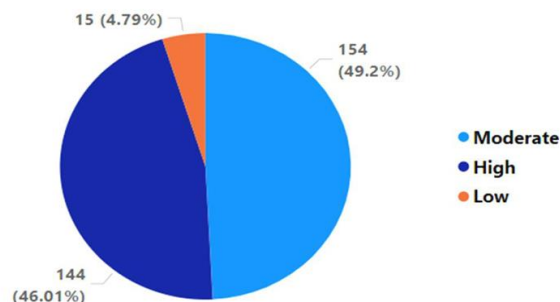


Figure 16. Middle Class Fuel Price Impact.

Upper class

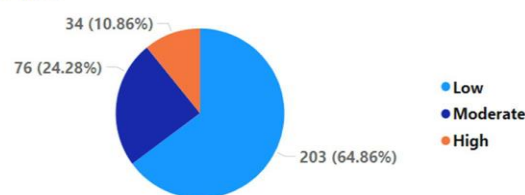


Figure 17. Upper Class Fuel Price Impact.

Here, I can conclude that most of the people have perception that lower class is affected the most as compared to middle and upper class.

7.11. Currently Monthly Expenditure Compared to Three Years Back Monthly Expenditure

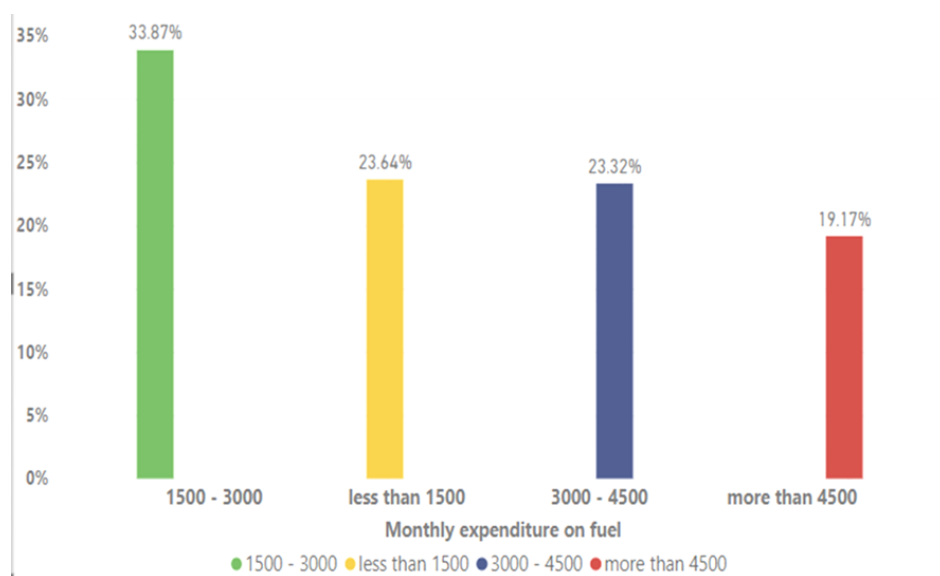


Figure 18. Distribution of Monthly Fuel Expenditure.

It's seen that 23.64% people are spending less than 1500 on fuel and 19.17% people's expenditure on fuel is more than 4500.

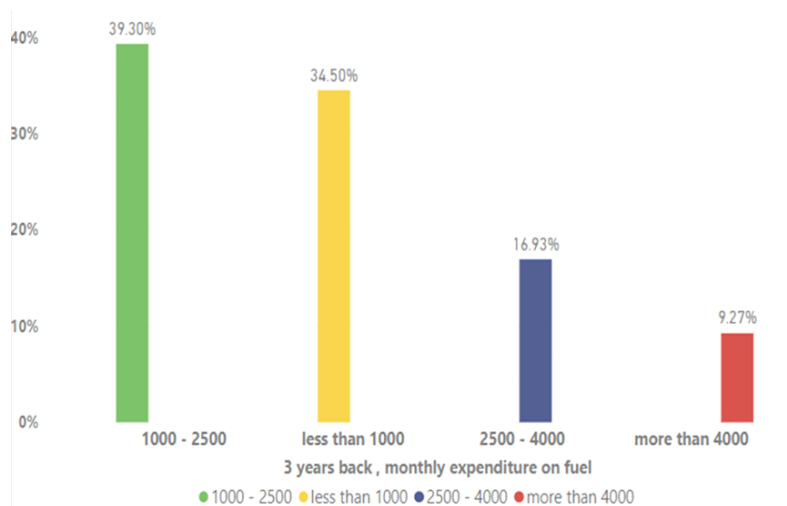


Figure 19. Monthly Fuel Expenditure 3 Years Ago.

In 3 years back, 34.5% people's expenditure was less than 1000 and only 9.27% people were spending more than 4000.

7.12. Responsible Elements for Continuous Hike in Fuel Prices

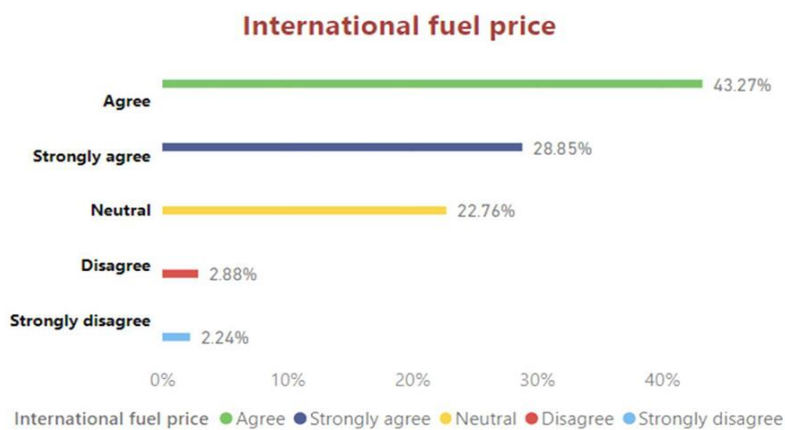


Figure 20. International fuel price.

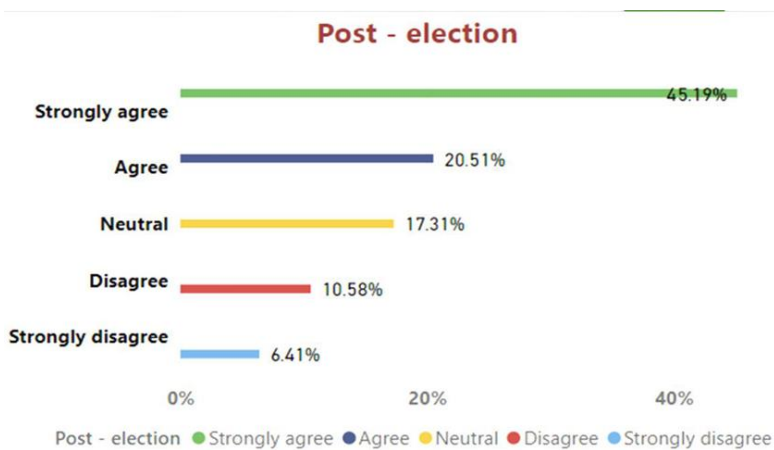


Figure 21. post-election.



Figure 22. Russia-Ukraine war.

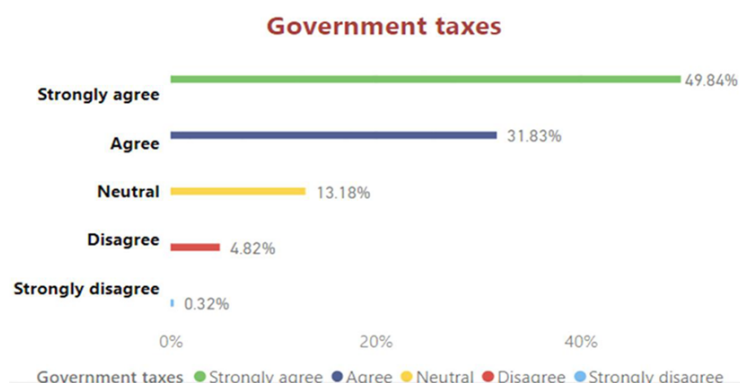


Figure 23. Government taxes.

Here, 43.27% people agree that international fuel price is one of the elements that cause the rise of fuel price.

Here 45.19% respondents strongly agree that post-election is contributing to the cause of increase in rise fuel price.

45.51% responds that Russia-Ukraine war is also another cause causing rise in fuel price, 30.45% also responds that

they agree about it. When we compare according to the responds, we realize that most people agree as compared to those who disagree.

Among all the elements, government taxes are leading with 49.84% responds. Most people believe that increase of taxes is the main cause of rise in fuel prices.

8. Some Visualization of Kenya's Data

8.1. Age Group

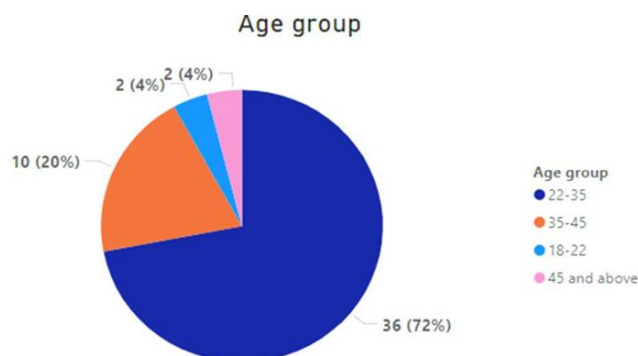


Figure 24. Age group.

8.2. Gender

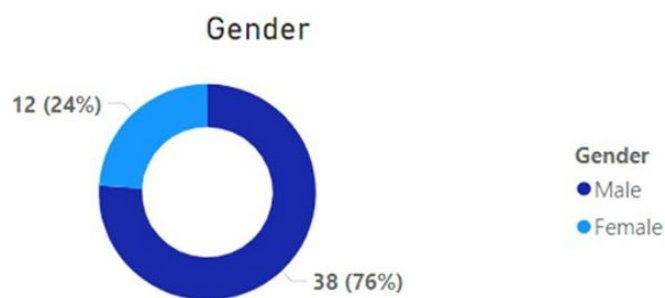


Figure 25. Gender.

8.3. How Much Kenyan People Are Concerned with the Continuous Hike in Fuel Price

More Not a concern

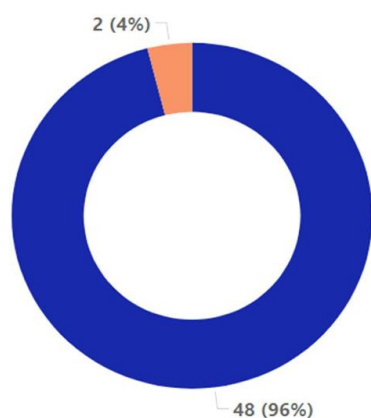


Figure 26. Fuel Price Fluctuation Concern Level.

Monthly expenditure on fuel?

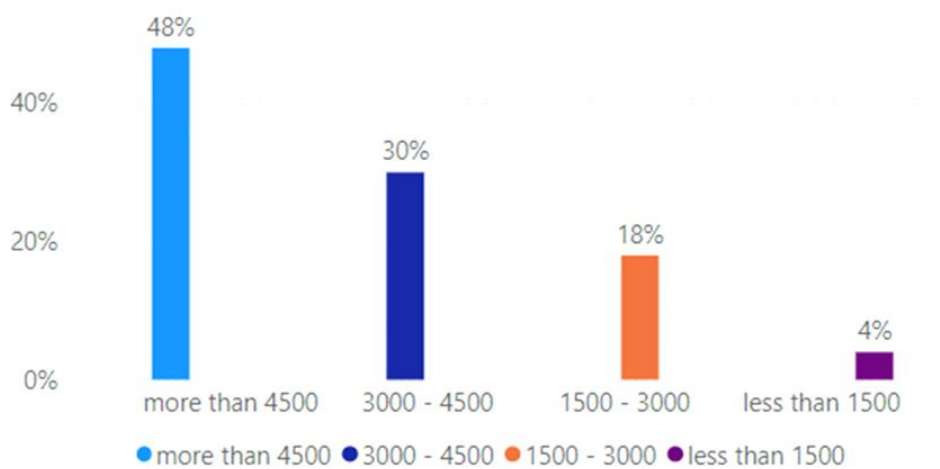


Figure 27. monthly expenditure on fuel.

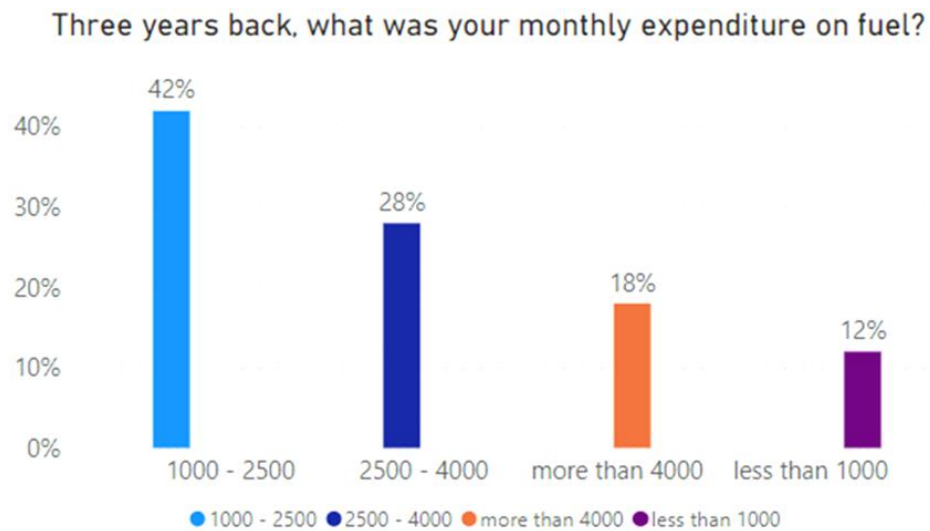


Figure 28. Monthly Fuel Expenditure 3 Years Ago.

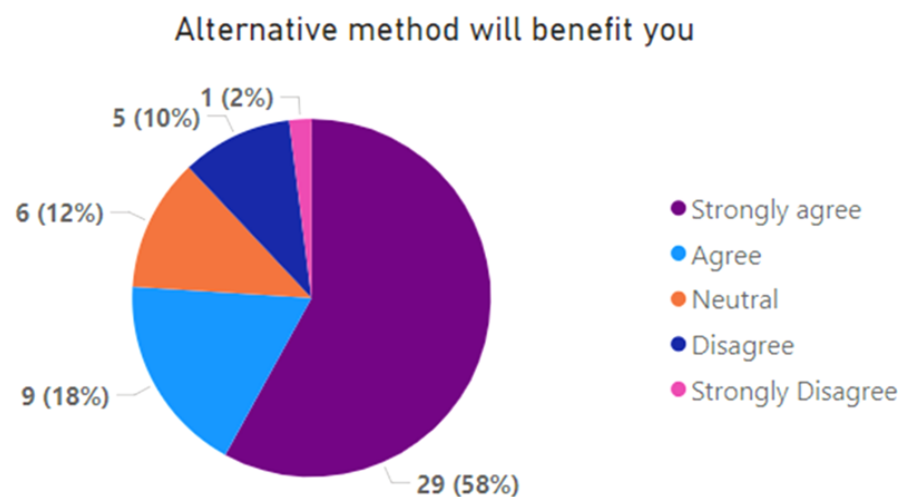


Figure 29. Perceived Benefits of Alternative Methods.

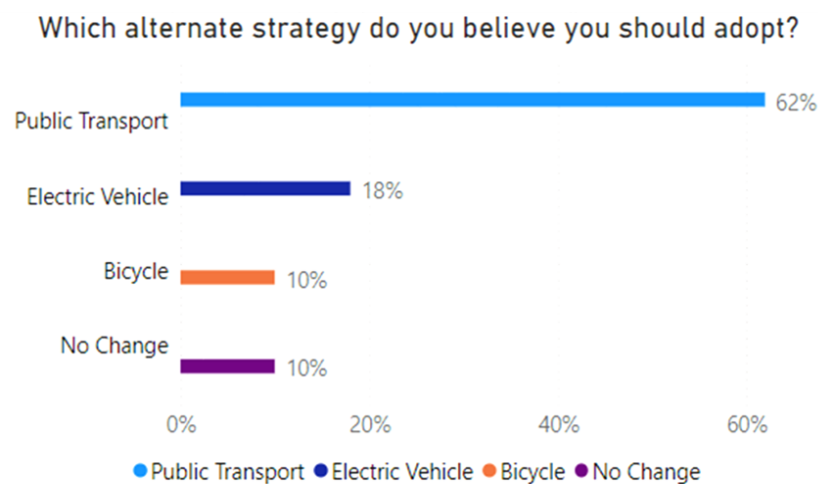


Figure 30. Alternate strategy to adopt.

What is your reaction whenever you hear about rising fuel prices?

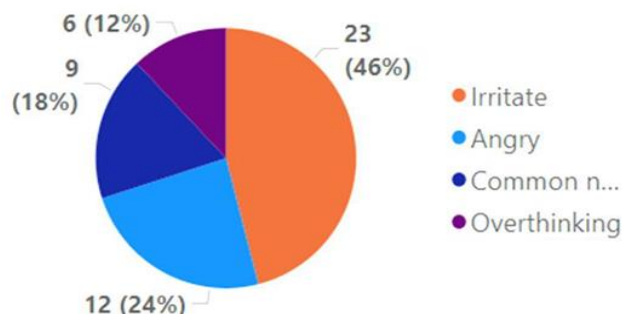


Figure 31. Reaction about the rising fuel prices.

What kind of problem you are facing?

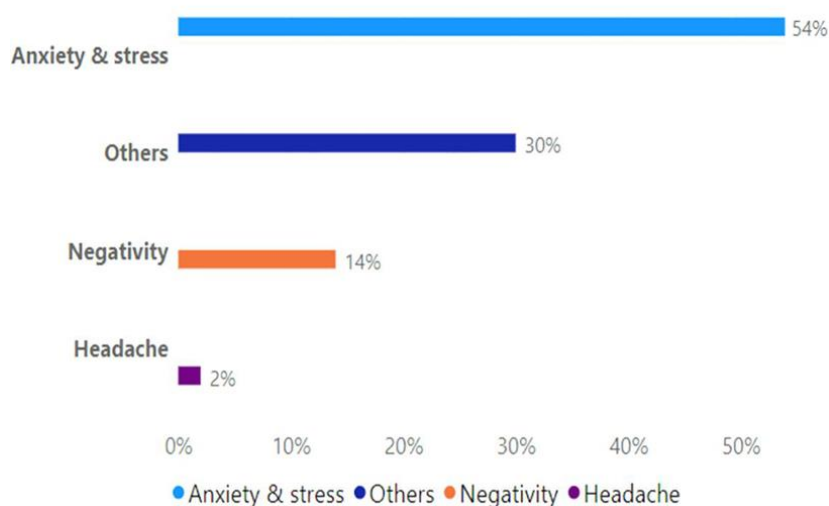


Figure 32. kind of problems faced.

Above graph shows that people are facing problems when there is rise in fuel prices, for instance, 54% of respondents are anxiety and stress.

After analyzing, we can conclude that like India, Citizens of other countries also facing the consequences of rising fuel prices. Most of the graphs are common and people have same perception. So, rise in fuel prices is not just a country's problem, It is a world-wide problem.

9. Statistical Analysis

Statistical tools used for the analysis are -:
SPSS, R and Python, MS Excel and Power BI.

9.1. Chi-Square Test

The Chi-Square test is a statistical method used to assess whether there is a significant difference between expected and actual outcomes in categorical data. It helps determine if any observed variation is simply due to random chance or if it indicates a meaningful association between the variables involved.

Formula for Chi-Square Test;

$$\chi^2_c = \frac{\sum (O_i - E_i)^2}{E_i}$$

Where;

C- Degrees of freedom

O-Observed value

E- Expected value

i. Is there any Association between Monthly Income and Monthly Expenditure on Fuel?

Hypothesis:

H_0 : There is no association between monthly income and monthly expenditure on fuel.

H_1 : There is an association between monthly income and monthly expenditure on fuel.

Observed Frequency:

		Monthly Income					
		less than 20000	20000 - 35000	35000 - 50000	50000 - 65000	more than 65000	Total
Monthly Expenditure On fuel	less than 1500	61	10	2	1	0	74
	1500 - 3000	58	31	10	3	4	106
	3000 - 4500	22	21	15	8	7	73
	more than 4500	6	13	16	12	13	60
	Total	147	75	43	24	24	313
chi-square (Cal)		29.704					df = (r-1)*(c-1) = 12
= Chi-square		21.026					
(tab)= P value =		6.84709E-18					

Figure 33. Monthly Expenditure on Fuel vs. Monthly Income.

Here Chi-square (cal) > chi-square (tab), 29.704 > 21.026.

I conclude that there is an association between monthly income and monthly expenditure on fuel.

ii. Is there any association between gender and people are concerned with hike fuel price?

Hypothesis;

H_0 : There is no association between gender and people are concern with hike fuel price.

H_1 : There is an association between gender and people are concern with hike fuel price.

	Less	More	Not a concern	Total
Female	23	97	12	132
Male	23	151	7	181
Total	46	248	19	313
chi-square (cal) =	5.539			
Chi-square (tab)=	5.991			
P value =	0.062703759			
df = (r-1)*(c-1) = 2				

Figure 34. Gender vs. Concern Level.

Chi-square (cal) < chi-square (tab), 5.539 < 5.991

I conclude that there is no association between gender and people concern with hike fuel price.

iii. Is there any association between monthly income and mental health concern?

Hypothesis;

H_0 : There is no association between monthly income and mental health concern.

H_1 : There is an association between monthly income and mental health concern.

Mental Health Concern					
Monthly Income		Yes	No	Not a concern	Total
	Less than 20000	97	41	9	147
	20000 - 35000	42	29	4	75
	35000 – 50000	24	16	3	43
	50000 – 65000	15	5	4	24
	More than 65000	10	12	2	24
	Total	188	103	22	313
Chi-square (cal)=		11.594			
Chi-square (tab)=		15.507			
Total =		0.170237428			
df = (r-1)*(c-1) = 8					

Figure 35. Mental Health Concern.

Chi-square (cal) < chi-square (tab)

11.594 < 15.507

I conclude that there is no association between monthly income and mental health concern.

iv. Is there any association between age group and monthly expenditure on fuel?

Hypothesis;

H_0 : There is no association between age group and monthly expenditure on fuel.

H_1 : There is an association between age group and monthly expenditure on fuel.

	Less than 1500	1500-3000	3000-4500	More than 4500	Total
18-22	38	31	12	11	92
22-35	20	41	28	15	104
35-45	5	16	18	19	58
45 and above	11	18	15	15	59
Total	74	106	73	60	313
Chi-square (cal) =	37.822				
Chi-square (tab)=	16.9189776				
P value =	1.87585E-05				

df = (row -1)*(column-1)= 9

Figure 36. Age Group vs. Monthly Fuel Expenditure.

Chi-square (cal) > chi-square (tab)

37.822 > 16.9189776

I conclude that there is an association between age group and monthly expenditure on fuel.

v. Is there any association between people concern and mental health concern?

Hypothesis;

H_0 : There is no association between people concern and mental health concern.

H_1 : There is an association between people concern and mental health concern.

		Mental Health Concern			
		Yes	No	Not a concern	Total
People concern	Less	20	19	7	46
	More	161	75	12	248
	Not a concern	7	9	3	19
	Total	188	103	22	313
Chi-square (cal) =		15.66979738			
Chi-square (tab)=		9.488			
P value =		0.003495814			

df = (r-1)*(c-1) = 4

Figure 37. mental health concern.

Chi-square (cal) > chi-square (tab), 15.67 > 9.48

I conclude that there is an association between people concern and mental health concern.

9.2. Multiple Response Analysis

9.2.1. Where Are You Going to Cut Costs to Satisfy the Fuel Price Requirements

I observe from this analysis that 43.4% respondents reduce their expenditure on travel and tourism, 33.4% respondents reduce their expenditure on Entertainment, and 11.6% respondents reduce their expenditure on Grocery and Healthcare due to increase in fuel price.

\$Responses Frequencies				
		Responses		Percent of Cases
		N	Percent	
Multiple Responses	Travel and Tourism	161	43.4%	52.6%
	Grocery items	43	11.6%	14.1%
	Entertainment	124	33.4%	40.5%
	Healthcare	43	11.6%	14.1%
Total		371	100.0%	121.2%
a. Dichotomy group tabulated at value 1.				

Figure 38. Responses Frequencies.

9.2.2. What in Your Opinion Will Be the Most Effective Remedy for Decreasing Fuel Prices

\$Responses Frequencies				
		Responses		Percent of Cases
		N	Percent	
Multiple Responses ^a	Include fuel in GST	118	21.1%	37.7%
	Cut in state - level taxes	156	27.9%	49.8%
	Reduce in transportation and logistics charges	68	12.2%	21.7%
	Use of Biofuel	93	16.6%	29.7%
	Use of electric vehicles	124	22.2%	39.6%
Total		559	100.0%	178.6%
a. Dichotomy group tabulated at value 1.				

Figure 39. Responses Frequencies.

I observe from this analysis that 27.9% respondents prefer Cut in state - level taxes because most effective remedy for decreasing fuel price.

10. Conclusion

According to the survey, I found that 79.23% people are more concerned with the continuous hike in fuel prices. According to type of vehicle, I found that 61.02% people own 2-wheeler as compare to 22.68% people who own 4-wheeler, this is because 2-wheeler consumes less fuel as compare to 4-wheeler hence cheaper means of transport. Monthly expenditure on fuel according to age group, I found that the age group between 18-22 years, 41.30% spend monthly ex-

penditure of less than 1500 on fuel, age group between 22-35 years, 39.42% spend 1500-3000 monthly expenditure on fuel, age group between 35-45%, 31.03% spend monthly expenditure of 3000-4500 on fuel and above age of 45 years I found 30.51% spend 1500-3000 on monthly expenditure of fuel. Due to rise in fuel price, 133 respondents agree that pursuing an alternative method will benefit them, 35% of the respondents proposes that use of public transport will save them on their monthly expenditure of fuel since it's cheaper than using private means. Also, I realized that most people face mental problems, 188 respondents agree that they experience mental health concern as a result of the daily fluctuation in fuel prices. The government must investigate the factors that contribute to rising fuel prices and identify solutions, as this has an impact on citizens' living standards, as people

divert funds from other areas to pay for fuel. In our survey, 69.65% of people have perception that lower class is affected the most has compared to middle and upper class. In three years back, 34.5% people's expenditure was less than 1000 and only 9.27% peoples were spending more than 4000. Now, in the current price of fuel, 23.64% of people are spending less than 1500 on fuel and 19.17% of people's expenditure on fuel is more than 4500. People's perception on elements causing rising of fuel prices is that 49.84% responds agree that government taxes contribute to increase in fuel prices, followed by Russian Ukraine war with 45.15% response, post-election with 45.19% and international fuel price with 43.27% response. We managed to collect data from few people from Kenya and according to their response, 96% of people are concerned with the increase in fuel price. We also find that the two countries face similar problems of fuel price, India with Rs 100 per litre and Kenya with Ksh 144.62 (Rs 102) per litre. The price of gasoline is an important macroeconomic indicator. Higher oil prices could harm the economies of oil-importing countries, as well as the global economy. Several countries are seeing higher inflation rates as a result of the oil prices have risen dramatically over the world. As a result, Inflationary pressures harm both production and consumers, resulting in a substantial difference between oil- importing and oil-exporting countries. As per the research, rising product and service prices have a macroeconomic impact, resulting in higher production costs and, as a result, higher production output costs. Households' real income will be affected by rising domestic petroleum prices directly through higher prices paid for direct petroleum use, and indirectly through higher prices paid for indirect petroleum use. In our report also, people were demanding to cut on taxes which would definitely reduce the fuel prices. And the step taken by government will definitely provide relief to citizens and it will help them to reduce their stress and anxiety.

Abbreviations

Vs	Verses
Cal	Calculated
Tab	Tabulated

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Conflicts of Interest

The author declares no conflicts of interest.

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