PATTERN OF FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN AIZAWL CITY

A dissertation submitted to partial fulfillment for the award of the degree of Master of Philosophy in Economics

by

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I, Lalmuanzuali, do hereby declare that the M. Phil dissertation entitled “Pattern of Fuel Consumption Among Two-wheeler Owners in Aizawl City” being submitted to the Department of Economics, Mizoram University for partial fulfillment of the Degree of Master of Philosophy in Economics, is a record of research work carried out by me and this dissertation has not been submitted by me for any research degree in any other University or Institution.

This is being submitted to the Mizoram University for the degree of Master of Philosophy in Economics.

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LIST OF ABBREVIATIONS

BPCL	Bharat Petroleum Corporation Limited
CC	Cubic Centimetre
Govt.	Government
HMV	Heavy Motor Vehicle
HPCL	Hindustan Petroleum Corporation Limited
HSD	High Speed Diesel
IOC	India Oil Corporation
IOCL	Indian Oil Corporation Limited
KL	Kilo Litre
LMV	Light Motor Vehicle
LPG	Liquefied Petroleum Gas
MS	Motor Spirit
ONGC	Oil and Natural Gas Commission
SKO	Superior Kerosene Oil
XP	Extra Premium

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Fuels can be regarded as household necessity nowadays since almost every household has at least motorized two wheelers with them. The fuels wipe out the needs for the owners of the vehicles. Consequently, demand for more fuels for vehicles, industries, machines etc. depends on the economic growth of the country. On the other hand, vehicles obtain its power by burning fuel. Fuel consumption may be affected by the choice of travel speed, purpose of riding, distance of travel route, condition of roads etc. Smoother riding has the potential for reducing fuel consumption; it may also help in reducing emissions. The fuel economy of two wheelers is the fuel efficiency relationship between the distance travelled and the amount of fuel consumed by it. Consumption of fuel can be expressed by the volume of fuel to travel a distance or the distance travelled per unit volume of fuel consumed. Fuel consumption is a more accurate measure of vehicle performance.

Two wheeler industries have been in India since 1955. It consists of three segments Mopeds, motorcycles and scooters/ gearless scooters. Two-wheeler plays an important role in the growth of the Indian automobile industry. The demands for two wheelers have witnessed a sea change over the years. With the rising income levels and standard of living, there is a rapid rise in the demand for two wheelers in the country. Some of the two wheeler manufacturers in India are- Hero

Honda Motors Ltd, Bajaj Auto, TVS Motor Company, Majestic Auto Ltd, Kinetic, Suzuki Bikes and Scooters.

Fuels contributed to industrial and economic growth. According to Industrial Energy Agency, cars will be one of the primary drivers of energy demand in the transport sector in the coming decades. Both two wheeler numbers as well as the average fleet mass are expected to increase in the future. Many roads in India are narrow; two wheelers navigate such roads easily. With in increasing cost of petrol, two-wheeler makes daily travel more convenient and cheaper. In developing countries like India, two wheelers are overwhelmingly utilitarian due to lower prices and greater fuel economy. Two-wheelers make life simpler and easier in India. It is also used to carry goods, for works and for private transportation. Majority of the Indian youngsters prefer two wheelers to cars as it is fashionable and affordable. Two wheelers have mobility advantages rather than other vehicles especially in India where lots of narrow roads are found in different parts. It is a fast mode of transportation that saves time and energy. Urban public transport in India is underdeveloped resulting in congestion on roads due to mixed traffic. Congestion of traffic systems have led to increased dependence on small, motorized vehicles.

Two wheelers in Mizoram use only petrol fuel. It is well-known that during the last three decades, there has been a rapid increase in vehicle population in Mizoram. This study analyses fuel consumption by

households and whether they value fuel efficient vehicle or not. This study is necessary since the vehicle owners in Aizawl city may not keep in mind the fuel efficiency while purchasing their vehicles, they may care only for the model, its engine size and the price only. The less efficient vehicles may be less expensive while purchasing but when considering its fuel consumption, the less efficient vehicles may be highly expensive later on. Therefore, it is necessary to care for vehicles that reduces fuel and emissions.. Aizawl is encouraged by the expanding number of two wheelers. The demand for more fuels has created insufficiency of fuels in the study. An empty fuel in fuel pumps even just for a day has become a huge problem these days. The deteriorating quality of public transport may also drive the people to personalized transport. Rise in disposable income affect the purchasing level of two wheelers and other vehicles.

1.1.1 Fuel

Fuels are any materials that store potential energy in forms that can be practicably released and used for work or as heat energy. The concept originally applied solely to those materials storing energy in the form of chemical energy that could be released through combustion. The heat energy released by many fuels is harnessed into mechanical energy through an engine. The first known use of fuel was the combustion of

wood or sticks by Homo erectus near 2,000,000 (two million) years ago. Liquid fuels in widespread use are derived from the fossilized remains of dead plants and animals by exposure to heat and pressure in the Earth's crust. Many liquid fuels play a primary role in transportation and the economy. Fossil fuels are hydro-carbons, primarily coal and petroleum, formed from the fossilized remains of ancient plants and animals by exposure to high heat and pressure in the absence of oxygen in the Earth's crust over hundreds of millions of years. Fossil fuels are non-renewable resources because they take millions of years to form, and resources are being depleted much faster than new ones are being made. Therefore, conservation of these fuels is a must.

1.1.2 Petroleum

The word 'Petroleum' has been derived from two Latin words Petra (meaning rock) and Oleum (meaning oil). Thus petroleum is oil obtained from rocks; particularly sedimentary rocks of the earth. Therefore, it is called mineral oil. Technically speaking, petroleum is an inflammable liquid that is composed of hydro-carbons which constitute 90-95% of petroleum and the remaining is chiefly organic compounds. Petroleum has an organic origin and is found in sedimentary basins, shallow depressions and in the seas. Petroleum and petroleum products are mainly used as motive power. It is used in manufacturing a wide

variety of materials, and it is estimated that the world consumes about 90 million barrels each day. The use of petroleum has also a negative impact on Earth's biosphere, damaging ecosystems through events such as oil spills and releasing a range of pollutants into the air. Petroleum has been used since ancient times, and is now important across society, including in economy, politics and technology. The rise in importance is due to the invention of the internal combustion engine and the rise in commercial aviation. Today, about 90% of vehicular fuel needs are met by oil. At present, the top 3 oil producing countries are Russia, Saudi Arabia and the United States. Petroleum is vital to many industries, and is of importance to the maintenance of industrialized civilization itself, and thus it is a crucial concern to any nations.

1.1.3 Diesel

Diesel fuel is any liquid fuel used in diesel engines, whose fuel ignition takes place, without spark, as a result of compression of the inlet air mixture and then injection of fuel. Diesel fuel originated from experiments conducted by German scientist and inventor Rudolf Diesel for his compression-ignition engine he invented in 1892. Diesel is generally simpler to refine from petroleum than gasoline. Diesel fuel is mostly used in most types of transportation. Diesel engines are lean burn engines, burning the fuel in more air than is needed for the chemical

reaction. Thus, they use less fuel than rich burn spark ignition engines. Diesel-powered cars generally have a better fuel economy than equivalent gasoline engines and produce less greenhouse gas emission. Their greater economy is due to the higher energy per-litre content of diesel fuel and the intrinsic efficiency of the diesel engine. Diesel fuel is produced from various sources, the most common being petroleum.

This study analyses household economic behaviour with regards to fuel consumption deviates from the well beaten path of primitive economy. Households having the capability of consuming fuel oil naturally belong to the middle class or elite group of the society. In temporal sense, the spurt of oil consumption is comparatively recent phenomenon in Mizoram though the first car oil-refinery was set up in USA in 1850. Furthermore, the use of motorized vehicle is possible only when there is a good network of roads.

1.2 TRANSPORT

Transport is an important part of an economy. The automobile industry is rapidly growing. It has emerged as the dominant part of the transport system. However, the industry is finding it difficult to meet emerging requirements. This may be partly due to the inadequacies of the road network, which if expanded and upgraded could go a long way in promoting efficient vehicle operations. Transport systems and city

character are interlinked and also land use characteristics of a city can determine the type of transport systems it needs. They are extremely popular and versatile not only as passenger carriers but also as goods carriers. Indians prefer motorcycles because of their small manageable size, low maintenance and pricing, and easy loan payments. The Indian two wheeler industry has come a long way. There is an increase in vehicle and an ever-increasing demand for fuels in the whole world. In India, two-wheeler market is noticing a continuous upsurge in demand and thus resulting in growing production and sales volume. Recently launched gearless scooty cater to the needs of both men and women, while motorbikes are a segment mostly preferred by men only but bikes are also preferred by women in some parts of India. This is also happening in the state of Mizoram. It had been recorded that, in 1972, while the state is a Union Territory, there was only 90 vehicles in Mizoram. In 1987, when Mizoram had attained its Statehood, vehicles had increased to 6,518. Then, in 2008-09 the number of vehicles registered in Mizoram had reached 69,882. An economy is growing, so too has disposable income, which in turn has led to an increase in the number of vehicles in every part of the world. In general, pedestrians, cyclists, moped and motorcycle riders are the most vulnerable road users in poor countries. Even in a small state like Mizoram, majority of the people who own vehicles are two-wheeler owners. Since the year 2000, 50% of the vehicles registered in Mizoram are two-wheelers. In view of

Mizoram economy and its road conditions, two- wheelers are convenient to use in traffic jams on such small-sized roads. Development has also reached Mizoram in many ways, as compared to few year back there is a great change in the number of vehicles registered.

In urban areas, the number of two wheelers has increased significantly. The automobile pollution is majorly caused due to its combustion which forms the exhaust emission. Traffic emission has become a major concern in most of the countries in the world. Besides the health effects, traffic emission also contributes high economic losses. The rapid increase in urban population has resulted in unplanned urban development, increase in consumption patterns and higher demand for transport and energy sources which lead to automobile pollution.

1.3 OBJECTIVES OF THE STUDY

i) To study the factors that influences the selection of vehicle by customers.

ii) To examine the pattern of fuel consumption among the two-wheeler owners.

iii) To identify the different types of fuels consumed by the two-wheeler owners and also to analyze the pattern of sells by the filling stations.

1.4 RESEARCH QUESTIONS

1. Which among the two-wheeler vehicles consume more fuel depending on their cubic centimetres?

2. Is there any difference in the expenditure on fuel consumption among the employed and unemployed riders?

1.5 METHODOLOGY

The study is carried out with the help of Primary and Secondary data. Primary data is collected through field survey and by studying questionnaires to prospective respondents, the attitude of motorized two-wheeler owners towards their vehicles and their socio-economic life as well. Secondary data is collected through an official document of Mizoram State Transport Department and Directorate of Food, Civil Supplies and Consumer Affairs, Government of Mizoram and also from websites. The survey was conducted through structured questionnaires by taking sample size of 70 two-wheeler riders in Aizawl city. There are only 10 filling stations in Aizawl as recorded by the Indian Oil Corporation Limited (IOCL), Vairengte. Besides these, there are three other stations who import their oils from the Hindustan Petroleum Corporation Limited (HPCL) and Bharat Petroleum Corporation Limited (BPCL), necessary information was also taken from these three fuel stations. Appropriate quantitative technique is also applied as an analytical tool wherever appropriate.

1.6 AREA OF THE STUDY

The Indian State of Mizoram is divided into eight districts viz., Aizawl, Lunglei, Kolasib, Lawngtlai, Saiha, Mamit, Serchhip and Champhai. Aizawl is the capital of the state of Mizoram and it is the largest city in the state. The district is bounded on the North by Kolasib district, on the South by Serchhip district and on the East by Champhai district. It is the centre of administration containing all the important government offices, state assembly house and civil secretariat.

As of 2011 India census, Aizawl had a population of 293,416. Females constitute 144,913 i.e. 50.61% of the population and males are made up the remaining 148,503 i.e. 49.39%. Sex ratio is 1029 per 1000 males. Aizawl is located north of the Tropic of Cancer in the Northern part of Mizoram. It is situated on a ridge 1,132 metres (3715 ft) above sea level.

Aizawl is connected by air transport through Lengpui Airport which is situated near Aizawl, a helicopter service by Pawan Hans was started in 2012. It is also connected by railroad up to Bairabi and by road with Silchar, Agartala and Imphal with National Highway 54, 40 and 150 respectively. The Aizawl Municipal Council (AMC) is the authority of civic administration of Aizawl City. It was formed in 2010 with 19 members. The AMC office is being administered by one council Chairman, Vice Chairman and three executive members.

1.7 STATEMENT OF THE PROBLEM

Development has brought about an increase in vehicles even in Mizoram and other parts of the world. These increasing vehicles demand for more fuels and further affected the consumption expenditure for fuels and also created insufficiency of fuels. Shortage of fuel in fuel stations just for a day has become a huge problem. Vehicles increase at a very fast pace in Mizoram especially in Aizawl city, among these vehicles, two-wheelers contribute the largest share and almost every households own two-wheelers in Aizawl. Fuel pumps are also located in other districts of Mizoram but major problems occur in Aizawl because of its highest population density. Aizawl is encouraged by the expanding number of two wheelers and how this affects the consumption of fuel in Aizawl among the owners of the motorized two-wheelers. There is no specific study about the consumption patterns and the supply of fuels in the City to meet its requirements. Therefore, the study about the consumption of this necessity is required to find out how far the Aizawl city has its dependence on fuels in everyday life.

CHAPTER 2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

This chapter brings out the applicable literature review in order to shore up the present study. The following recent literature studies are concerned with the present study and are endowed with the required information and techniques that would be supportive for the current study.

Haworth N et.al (2001), in their report examines the possible safety benefits from driving in a manner that result in lower fuel consumption and emissions. Both road safety and the environment are critically affected by the extent of the use of motor vehicles and the specific ways in which they are driven. It attempts to assess the potential of promoting additional motivations to drive safely-better fuel economy and other environmental outcomes, and reduced running costs. From an environmental perspective, fuel consumption results in the production of vehicle emissions which can be classified into air pollutants (which affect health) and greenhouse gas (which affect the environment). Fuel consumption also depletes stocks of non-renewable fossil fuels. Total fuel consumption can be decreased by reducing vehicle travel or by reducing fuel consumption rate (improving fuel economy). This report focuses on the safety effects of measures that improve fuel economy, rather than the effects of reduced vehicle travel. The scope of the report is confined to passenger cars and light trucks. Smoother driving has great potential for reducing fuel consumption and emissions in urban

areas than in open road travel. At the level of individual vehicle, smoother driving can lead to greater reductions in fuel consumption than lower travel speeds in urban areas. The resulting reduction in emissions of air pollutants is expected to be greater than the reduction in greenhouse gas emissions. The environmental benefits of smoother driving may be greater than the road safety benefits but this is yet to be established. More information is needed about the road safety effects of smoother driving. The possible effect on following distance of drivers attempting to maintain a steady speed has not been investigated. The nature of instructions to be given to drivers, particularly of automatic vehicles, needs further study. Further work on the interaction between driving style, speed limit and street length should be undertaken to establish whether different instructions should be given according to these variables. The case study found that the fuel consumption rate of crash-involved vehicles was higher than that of vehicles not involved in crashes and demonstrated the feasibility of this method. It also showed that while fuel consumption may be easier to measure than safety levels, data manipulation and quality control may be time consuming. Thus, reducing speeding, lower speed limits and modifying driving style were found to improve fuel economy and other environmental outcomes in addition to improving safety. Community attitude surveys suggest that there will be greater support for measures that aim to improve fuel economy than for those that attempt to reduce vehicle travel. In addition,

reducing fuel consumption rate without requiring a change in vehicle choice may be more acceptable and more easily implemented in the short-term. Comparisons before and after training in driving to reduce fuel consumption and analytical studies based on fleet data are recommended as measures of the safety effects of fuel efficient driving.

Padam S et.al, (2004), in their paper attempts to highlight the need for a cogent urban transport policy without which there will be ad hoc interventions. Such interventions, apart from not adding up to a comprehensive approach, will result in greater confusion. Furthermore, it emphasizes that if there is no worthwhile public transport, it will still need to be reinvented to promote a better quality of life. The need of the hour is formulation of an urban transport strategy that is both pragmatic and holistic in its approach. Cities play a vital role in generating economic growth and prosperity. The sustainable development of cities largely depends upon their physical, social and institutional infrastructure. In this context, the importance of transport infrastructure is paramount. To facilitate this, what is required is a sound urban transport policy. The urban population in India has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to grow to around 540 million by the year 2021. In terms of percentage of total population, the urban population has gone up from 17% in 1951 to 29% in 2001 and is expected to increase up to around 37% by the year 2021. Consequently, the number and size of cities have

also increased considerably. Although circumstances differ considerably across cities in India, certain basic trends which determine transport demand (such as substantial increase in urban population, household incomes, and industrial and commercial activities) are the same. These changes have placed heavy demands on urban transport systems, a demand that many Indian cities have been unable to meet. Among various factors affecting the quality of life and safety in a city, the transport system is among the most important. It has a direct correlation with air quality and safety. The urban transport situation in large cities in India is deteriorating. The deterioration is faster in metropolitan cities where there is an excessive concentration of vehicles. Commuters in these cities are faced with acute road congestion, energy wastage, rising air pollution, and a high rate of accident risk. It is no longer safe to walk on the road or to ride a bicycle. Mass transport is scarce, overcrowded, unreliable, and involves long walking periods. Considering the population growth in most Indian cities, the urban transport infrastructure thus needs to be increased manifold over the next few years, if the gap in the demand and supply has to be eliminated. The vehicle operating speed on many roads in metropolitan cities has declined, ranging from 15% to 50% over the last two-decades. The development of roads and infrastructural facilities has not kept pace with the growth of motor vehicles. The transport crisis faced by most of the metropolitan cities in India harms business efficiency, threatens to

undermine the city's competitive position, and worsen the people's quality of life. Without vigorous action, all of these problems would intensify, as rising population over the coming decades and the goal of growing economic prosperity put more pressure on the system. Achieving this requires not only overcoming chronic under-investment, but also a complete overhaul of public transport management. It is high time the decision-makers take necessary action to make cities viable. The complexities of urban transport cannot be resolved without a concise and cogent policy. Urban areas, whether mega-cities, cities or towns, have grown and are growing. The demands they are making have remained largely unmet. The deteriorating quality of public transport is driving people to personalized transport, most of which are fuel-inefficient, congesting and unsafe. While it is not the intention of this paper to make a case against large capital intensive metro systems, the realities demand solutions which are within reach. Buses as a mode of public transport, have a potential which is yet to be fully exploited. Given the priority that they deserve, buses can ensure safety, act against pollution and promote mobility for the poor and the not so poor.

Agarwal O.P (2006), in his paper discusses that the increased travel demand has resulted in rapid growth in the number of motor vehicles in the cities. In the six major metropolises of India, growth in motor vehicles has outpaced population growth. On an average, while the population in India's six major metropolises increased 1.89 times

during 1981 to 2001, the number of registered vehicles went up 7.75 times during the same period. Thus the growth of motor vehicles was almost four times faster than the growth of population. This growth has been largely driven by the growth in the number of two-wheelers. Figure 6.3 shows that the sale of two-wheelers has dominated the vehicle sales between 1993– 4 and 2001–2. The largest share of the vehicular fleet in the six metropolises also comprises of two-wheelers. Cities with better public transport systems, especially those with rail based mass transit systems—Kolkata and Mumbai—show a relatively lower share of two-wheelers and total registered vehicles. The large cities have faced major problems, which the smaller ones have, so far, not been noticeably affected by. Most prominent among them is the high level of air pollution caused by motor vehicles. Pavement dwellers, road side hawkers, cyclists and pedestrians are most dangerously exposed to motor vehicle exhaust. The emerging pattern of urban mobility has also had its impact on the consumption of petroleum products, which has gone up substantially. The net foreign exchange outflow on importing crude oil and petroleum products increased from about Rs 5250 crore in 1980–1 to Rs 1,12,000 crore in 2004–05 (GOI 2005). The rising trend in the consumption of petroleum products has a bearing on India’s energy security, especially because India depends on imports for a large share of its crude oil requirements. A strategy to reduce personal motor vehicle use is to promote the use of non-motorized modes as they are

‘greener’ modes of travel. Vehicles travelling at a steady speed emit fewer pollutants than a vehicle requiring frequent starts and stops or spending considerable time in idling. Hence the focus of traffic flow improvements is to enable a vehicle to move at a steady speed and reduce the incidence of starts and stops. Several measures are necessary to bring about the required improvements in public transport. To begin with a public transport system design, which can be developed within city constraints given the city’s topography, time taken to develop the systems and improve accessibility to people would be an ideal system. Urban public transport in India is underdeveloped resulting in congestion on roads due to mixed traffic. Unreliable and rudimentary public transport systems have led to increased dependence on small, motorized vehicles among urban population. Urban transport in most cities suffers from lack of planning as well as amorphous nature of responsibilities assigned to various central, state and local government agencies. Demand for urban transport is expected to double by 2030, hence, there is an urgent need to develop strategies, which will reduce demand for public transport without constraining growth and provide a healthy environment to urban dwellers. Mass transportation systems especially in a few metropolitan cities have moved from construction to the operational stage. The government has taken half-a-step by preparing a draft National Urban Transport Policy. The next half-step would be taken when regulatory reforms are put in place to provide

comprehensive urban public transport services at an affordable price to all.

Farsi M et.al, (2006), in their paper applies an ordered discrete choice framework to model fuel choices and patterns of cooking fuel use in urban Indian households. The choices considered are for three main cooking fuels: firewood, kerosene and LPG (liquid petroleum gas). The models, estimated using a large microeconomic dataset, show a reasonably good performance in the prediction of households' primary and secondary fuel choices. This suggests that ordered models can be used to analyze multiple fuel use patterns in the Indian context. The results show that lack of sufficient income is one of the main factors that retard households from using cleaner fuels, which usually also require the purchase of relatively expensive equipments. The results also indicate that households are sensitive to LPG prices. In addition to income and price, several socio-demographic factors such as education and sex of the head of the household are also found to be important in determining household fuel choice. In contrast to rural households, urban ones often have a wider choice and greater availability and accessibility to modern commercial fuels, electricity, and energy using end-use equipment and appliances, and therefore, greater potential for fuel switching. The rapid growth of urban areas in developing countries has been accompanied by a huge surge in the demand for household fuels and electricity. In India, the share of urban population increased

from 17.3% in 1951 to about 28% in 2001 and is projected to rise to about 41% by 2030 (UN, 2003). Changing urban lifestyles have important implications for the quantum and pattern of energy use in households residing in these areas and suggest various avenues for policy relevant research. In addition, an understanding of factors affecting fuel choices in urban households might also provide insights into how rural households might behave if supply of commercial fuels and access to markets were not constrained in these areas. In India, household energy is required to meet the needs for cooking and water heating and for lighting and powering electrical equipment and appliances. Therefore, an understanding of cooking energy consumption patterns is particularly important. Despite a major shift away from the use of biomass fuels towards commercial fossil fuels and electricity over the last two decades in urban areas, there are still many poor Indian households who rely on firewood as their primary source of cooking energy. As income increases households tend to switch from firewood to kerosene and then LPG (liquid petroleum gas). However, all households do not necessarily switch completely or, in other words, terminate the use of one fuel when taking up the use of another. LPG, when compared to kerosene or firewood, has clear health, environmental and efficiency benefits. From a methodological point of view, this paper differs from previous literature in that we assume that there is a natural order of progression in terms of the choice of fuels based on their

efficiency, ease of use, and cleanliness and therefore, we employ an ordered discrete choice framework to model fuel choice. The analysis shows that in the Indian context, such ordered models can be as useful and instructive as non-ordered multinomial models. The descriptive analysis and the econometric results reported in the paper suggest that the observed patterns in the data are consistent with the stylized "energy ladder" theory. In other words, there is an order in the distribution of energy shares by the primary fuel that depends to a large extent on the level of income of the household. Firewood and LPG at the two extremes are more likely to be used with kerosene in the middle, than with each other. However, the results also show that in addition to income, there are several socio-demographic factors such as education and sex of the head of the household, which are important in determining the choice of fuels in urban Indian households. Overall, fuel choice decisions in urban Indian households appear to be flexible and dynamic with many households maintaining the ability to use two or more different fuels for cooking at any given point in time. The results seem to suggest several reasons why households shift to the use of modern fuels. In urban areas, where firewood is often bought and opportunity costs for collecting wood are high, economic considerations and availability are crucially important in determining fuel choices. Higher incomes increase the ability of households to afford both the equipment and fuel costs of modern fuels like LPG, which are also more

widely available in urban areas. Better education increases the awareness of households of the negative health impacts associated with the use of firewood and also the advantages of modern fuel use, in terms of efficiency and convenience. In larger cities and areas where modern fuel supplies are more regularly and reliably distributed, households are more likely to choose modern fuels and less likely to require back-up or supplemental use of other fuels. In addition, households where women are more empowered are less likely to use less efficient wood. Other reasons, such as tastes, customs and status, may also influence fuel choice and require further investigation. From a policy point of view, our results suggest that in order to encourage households to make fuel substitutions that will result in more efficient energy use and less adverse environmental, social and health impacts, a subsidization of LPG gas provision, a promotion of higher levels of education, greater empowerment of women and a promotion of general economic development could be effective instruments. Given the high fiscal costs associated with LPG fuel price subsidies, however, it may be more sustainable to promote policies that promote rebates on the purchase of LPG stoves and easier access to credit or purchase on installment plans for the equipment needed to use cleaner fuels such as LPG in a more targeted fashion. In addition, since multiple fuels are more likely to be used by the poor and the share of secondary fuels in total cooking fuel consumption is higher for households in lower income groups, a LPG

fuel subsidy policy is likely to benefit richer rather than poorer households and may not result in a complete transition away from the use of inferior fuels like wood and kerosene. As the results of the analysis presented in this paper highlight several other variables in addition to fuel price as affecting fuel choice, this points also to the importance of exploring other policy options than pricing alone.

Treiber M et.al, (2007), in their working paper, one of the central questions in transportation science is the evaluation of environmental impacts and the external costs of vehicular traffic. Particularly, this requires a reliable estimation of the fuel consumption and associated emissions of, e.g., CO2, hydrocarbons, or particulate matter. It is particularly relevant to which degree the fuel consumption and the emissions are influenced by the frequent occurrence of congested traffic. Since consumptions and emissions depend strongly on the velocity and acceleration patterns, a detailed microscopic estimation tool is necessary for a sufficiently realistic estimation. In such models, the instantaneous fuel consumption is determined as a function of the actual speed, the instantaneous acceleration, and further parameters and state variables for the vehicle and the engine. Such models can be formulated in terms of nonlinear regression functions, or they can be based on physical principles. They are also contained in some traffic simulator . Because the physical model has more intuitive model parameters (such as mass, size, and air-drag coefficient) and is based on generally valid principles,

it is more straightforward to include new vehicle types compared to the regression models. The fuel consumption of vehicular traffic (and associated CO2 emissions) on a given road section depends strongly on the velocity profiles of the vehicles. The basis for a detailed estimation is therefore the consumption rate as a function of instantaneous velocity and acceleration. A model for the instantaneous fuel consumption that includes vehicle properties, engine properties, and gear-selection schemes and implements it for different passenger car types representing the vehicle fleet under consideration is presented. The model to trajectories from microscopic traffic simulation is applied. The proposed model can directly be used in a microscopic traffic simulation software to calculate fuel consumption and derived emission such as carbon dioxide. Next to travel times, the fuel consumption is an important measure for the performance of future Intelligent Transportation Systems. Furthermore, the model is applied to real traffic situations by taking the velocity and acceleration as input from several sets of the NGSIM trajectory data. Dedicated data processing and smoothing algorithms have been applied to the NGSIM data to suppress the data noise that is multiplied by the necessary differentiations for obtaining more realistic velocity and acceleration time series. On the road sections covered by the NGSIM data, it is found that traffic congestion typically lead to an increase of fuel consumption of the order of 80% while the travelling time has increased by a factor of up to 4. It is concluded that

the influence of congestions on fuel consumption is distinctly lower than that on travel time.

Anderson S et.al, (2010), discusses fuel economy regulations in the United States and other countries. A number of countries now regulate the fuel economy of new, light-duty vehicles, while others regulate the rate of carbon-dioxide emissions per mile, which is almost equivalent. These regulations have two main rationales. First, they require automakers to design more fuel-efficient vehicles or shift sales toward more efficient models. This lowers CO2 emissions, reduces dependence on oil markets subject to economic and political uncertainty, and mitigates other externalities associated with petroleum consumption. Second, fuel economy standards might address a market failure that arises when consumers misperceive the benefits of improved energy efficiency-that is, when they do not pursue cost-effective opportunities to improve energy efficiency to the extent they should. This rationale is controversial because information dissemination programs may deal with consumers' misperceptions more efficiently than fuel economy standards. The future effectiveness of fuel economy programs is difficult to gauge, given that the baseline fuel economy is sensitive to oil prices, technology costs, and other factors. In addition, the cost-effectiveness of the standards remains contentious, particularly due to uncertainty about how consumers value fuel saving benefits. At first glance, fuel economy regulations seem difficult to justify on welfare grounds, given that fuel

taxes-even in the United States-exceed most estimates for per-gallon climate damages. Even in the presence of a large, misperception-based market failure, and even if the social costs of global warming or oil dependence are high, fuel economy regulations may not be needed if fuel taxes can be adjusted. This paper first describes how different programs affect fuel use and other dimensions of the vehicle fleet. It then review different methodologies for assessing the costs of fuel economy regulations and discuss the policy implications of the results. It also compares the welfare effects of fuel economy standards with those of fuel taxes and assess whether these two policies complement each other.

Ardekani S.A et.al, (2010), in their research aimed at investigating any differences that might exist in fuel consumption and CO2 emissions when operating a motor vehicle on an Asphalt Concrete (AC) versus a Portland Cement Concrete (PCC) pavement under city driving conditions. The overall study goal is to recommend consideration of such user costs or savings in the life cycle analysis of alternative pavement designs for city streets. Vehicular fuel consumption and emissions are two increasingly important measures of effectiveness in sustainable transportation systems, particularly considering that mobile sources in the U.S account for the largest consumption of energy and generation of air pollution. In motor vehicles, CO2 is the by-product of the combustion process released to

the atmosphere as a tailpipe emission. It is one of the greenhouse gasses contributing to global warming. Improving energy efficiency of the transportation sector including improving vehicle shape, mass, engine size, and tire quality could play a vital role in reducing fuel consumption and exhaust gas emissions. Pavement surface condition and type and other surface characteristics such as skid resistance, roughness, and longitudinal slope could also affect vehicular fuel consumption. The study is conducted through direct fuel measurements in urban driving using an instrumental vehicle on two pavement types under two driving modes(constant speed and acceleration) and for two surface conditions(dry and wet). The main objective of this study is to compare fuel consumption and exhaust emissions of an instrumental test vehicle field measurement. The study focus is paved city streets since urban driving accounts for a substantial share of the total vehicular energy consumption and emissions generated. The study was conducted through field data collections using an instrumental van. It was observed that under urban driving speeds of 30mph, the fuel consumption per unit distance is lower on concrete pavements compared to asphalt pavements. The results were found to hold for either day or wet surface conditions, although wet surface conditions generally resulted in higher fuel consumption rates compared to dry conditions regardless of pavement type. All observed differences were found to be statistically significant at 10% level of significance. In pavement projects,

specifically, the focus has been on estimating carbon materials as well as the initial construction phase. A key finding of this study is that any such sustainability assessment must also consider the emission differences based on operations of motor vehicles on various pavement surfaces.

Greene D.L (2010), in his report shows that passenger cars and light trucks account for 44% of the petroleum consumed in the United States each year and produce 16% of total U.S greenhouse gas emissions (Davis, Diegel and Boundy, 2009). Given the importance of the automotive sector to the U.S economy, understanding the costs and benefits of fuel economy and greenhouse gas standards for light duty vehicles is of great importance. The economy impacts of vehicle standards depend on the functioning of the market for fuel economy. In particular, carefully chosen regulatory standards have been shown to increase or decrease private welfare depending on how consumers value future fuel savings (Fischer, Harrington and Parry, 2007). The question has been controversial for decades, with some analysts assuming the market functions efficiently (eg, Kleit, 1990; Austin and Dinan, 2005) while other assert that it does not (eg, Greene, German and Delucchi, 2009). This paper surveys the recent literature of studies addressing consumers' willingness to pay for fuel economy improvements, trade-offs between capital costs and fuel costs, and related economic research. Despite a substantial body of significant new econometric evidence, the

topic remains unresolved. In short, there is evidence supporting both sides and some in the middle, as well. Of the 25 distinctly different study estimates, 12 indicate that consumers significantly undervalue future fuel savings relative to a reference expected value based on average U.S statistics, 8 indicate that consumers' values are approximately equal to the reference expected value, and 5 indicate that consumers significantly overvalue fuel savings. With a very few exceptions, there are no obvious flaws in the methods or data used by these studies. This finding applies equally to the published and unpublished studies. There does not appear to be an obvious explanation for the widely divergent results. Neither model type, formulation of the variable representing fuel economy, data type, time period, nor any other readily identifiable factor shows a strong association with inferences about the values consumers place on fuel economy. The 15 studies using discrete choice models are evenly divided between under, equal and over-valuing fuel economy, studies using hedonic price, asset price and other models more often indicate under-valuing. Most of the 15 studies represent fuel economy interacted with the price of fuel, generally as fuel cost per mile. These studies are evenly divided between under-valuing, equally valuing and overvaluing. Six included fuel economy without interaction with the price of fuel, either as miles per gallon or gallons per mile. Of these, five found undervaluing and equal-valuing. Four calculated a discounted present value based on

assumptions about vehicle lifetime, usage and fuel price expectations. These differences suggest that there may be some insights to be gained by testing hypotheses about whether consumers respond differently to fuel price changes as opposed to fuel economy differences, or whether responses to the two variables are symmetric or asymmetric.

Reiner R et.al, (2010), in their study, Electric vehicles still represents a small niche market hardly exceeding 1% of the passenger car market today. However, due to major progress in battery technology, more vehicles with an electric operation mode are expected to enter the market within the next few years. New concepts and new technologies need to be developed to launch electrically chargeable vehicles suited for both individual and public mobility and for goods distribution in urban areas. Electrically chargeable vehicles promise many benefits to towns and cities, such as very low (plug-in hybrid electric vehicle - PHEV) to zero (battery electric vehicle - BEV) tailpipe emissions and reduced noise. It has been estimated that with current average European energy supply the greenhouse gas (GHG) emissions of electric vehicles would be less than 50% compared with conventional vehicles. Despite great opportunities and rapid development it has to be noted that diverse transportation needs call for a strategy based on the complementary use of electric vehicles instead of simple substitution of the existing combustion engine. It is therefore estimated that a realistic market share for new, electrically chargeable vehicles would be 3 to 10% by 2020 to

2025. However, the market penetration can be further increased if current technological and economic barriers are addressed, adequate infrastructure for power supply is developed and new mobility patterns are accepted by potential customers. Overall, the findings could be summarized as follows:

• Electric vehicles will be a radical innovation offering global market opportunities for European automotive industry, requiring not only new technological and infrastructure solutions but also significant changes in the mobility behaviour of our society.

• Electric vehicles can be regarded as a key option for reducing GHG emissions of the transport sector due to the existing energy mix in Europe.

• Significant RTD efforts are needed in order to enter mass production of electric vehicles (“industrialization of electro mobility”), especially for improved reliability and cost reduction of batteries.

• European car manufacturers (recently) became aware of the opportunities and challenges and started significant investments.

• Such investments would need to be coordinated in order to prepare a European lead manufacturing market for electric vehicles.

• Normalization and standardization at European and global level are of crucial importance for technology and market preparation of electric vehicles.

Banerjee I (2011), in his research paper aims to support such policy development by providing information on the substitutions among various categories of motorized vehicles owned by households. To this end, a primary survey was conducted in Surat, a prosperous, industrial city in western India in 2009. The survey involved home interviews of 196 motorized vehicle owning households. Aided by economic development, India is undergoing rapid motorization. Growth of car ownership and use is attributed to rising per capita income and introduction of many car models are promoting the growth of ownership and use of cars. This growth portends a sea change in a country that relies mostly on non-motorized and public modes of transportation. It also signifies the transformation to a car based lifestyle in a country where motorized two-wheelers are the dominant personal motorized vehicle. Such a transformation calls for various policy pertaining to auto-ownership that aim to i) reduce fuel emissions, ii) enable environmental protection, and iii) support infrastructure development. The research explains the effects of increased per capita income and of the decreasing sizes of households on the composition of motorized vehicle fleet. The analysis involves econometric modeling supplemented with qualitative observations based on interviews and interactions with the residents. The research focuses on the possible shift from motorized two-wheelers to cars, and the substitutions among different sizes of cars. It reveals that household income is the key determinant of the number

and the sizes of cars that households own, and that household size is a much less significant factor; smaller vehicles are preferred even by larger households. Some of the possible reasons for this preference are the relative expense of larger vehicles, lax enforcement of regulations allowing many more passengers than mandated by the seating capacity, and the need for maneuverability for driving in congestion and for parking. An integrated choice and latent variable model is used to study the effect of different attitudes on the type of vehicles purchased, such as new versus pre-owned motorized two-wheelers or different sizes of cars. The results reveal that underlying perceptions and cultural beliefs regarding the different modes of transportation. Along with increasing income, the household structure of the Indian population is also changing with traditional joint families giving way to nuclear families. The goal of this research is to study whether these changes would change the preference of personal motorized vehicle types.

Chuh R et.al, (2011), in his study investigates how fuel economy is valued in the Indian car markets; we compute the cost to Indian consumers of purchasing a more fuel-efficient vehicle and compare it to the benefit of lower fuel costs over the life of the vehicle. We use hedonic price functions for four market segments (petrol hatchbacks, diesel hatchbacks, petrol sedans, and diesel sedans) to compute 95 percent confidence intervals for the marginal cost to the consumer of an increase in fuel economy. It is found that the associated present value of

fuel savings falls within the 95 percent confidence interval for some specifications, in all market segments, for the years 2002 through 2006. Thus, it is failed to consistently reject the hypothesis that consumers appropriately value fuel economy. When we reject the null hypothesis, the marginal cost of additional fuel economy exceeds the present value of fuel savings, suggesting that consumers may, in fact, be overvaluing fuel economy. This paper examines how car buyers in India value fuel savings. The hypothesis that consumers accurately value fuel economy has also been tested using data on used car prices. Because the used car market is competitive, the prices of used cars should adjust to reflect changes in the price of gasoline. Indeed, if consumers correctly value fuel economy, prices should adjust fully to reflect the change in the present value of fuel expenditures. The debate over mitigating the environmental impact of India's rapidly expanding vehicle fleet has centered on reducing fuel consumption. One commonly cited justification for fuel economy standards, as opposed to higher fuel taxes, is the belief that consumers undervalue fuel economy when making purchasing decisions. This concern is addressed by comparing the cost to consumers of increased fuel economy to the associated fuel savings. Based on the estimates of hedonic price functions, null hypothesis cannot be rejected that the mean consumer equates the marginal price of fuel economy to the present value of fuel savings in the markets for petrol hatchbacks and petrol sedans. In the markets for diesel hatchbacks

and diesel sedans, however, we reject the null hypothesis for at least some specifications in all years. In the cases for which we can reject the null hypothesis, consumers appear to be overvaluing fuel economy and, therefore, buying too much of it rather than too little. To further understand the trade-offs faced by consumers, it is considered the choices faced by potential buyers of twins. Diesel versions of twins are, in general, more expensive than their petrol counterparts but have sufficiently lower operating costs as to more than offset the difference in purchase price. Net savings from purchasing a diesel twin are substantial. By choosing their vehicle over its petrol twin, diesel hatchback owners save the equivalent of 44 percent of the purchase price of their chosen vehicle; diesel sedan owners save 23 percent. In 2006, 74 percent of twin hatchback owners and 59 percent of twin sedan owners realized these savings by buying the diesel twin. Because of their lower monthly driving distance, forgone savings by owners of petrol twins are lower, but still substantial: petrol hatchback owners could have saved (on net) 23 percent of the purchase price of their chosen vehicles, and sedan owners 15 percent, by buying a diesel. This does not mean that buyers of petrol twins were irrational; they may have been willing to forgo these savings to drive a more powerful petrol vehicle. There are limits to what can be said using the data on vehicle characteristics and sales prices used in this paper. The next step in our analysis is to estimate models of vehicle demand and miles driven using

individual household data on vehicle purchases. These models can be used to compute the welfare effects of changes in fuel taxes (e.g., the impact of equalizing the cost of diesel and petrol) and of imposing fuel economy standards. If, for example, auto manufacturers in India were to meet fuel economy standards by reducing vehicle weight and horsepower, as was done in the United States (Klier and Linn 2008), this could result in a welfare loss to Indian consumers. To justify such an intervention, these losses should be compared to the welfare gains from reduced pollution, congestion, and dependence on foreign oil. Such a comparison of costs and benefits cannot be accomplished without first quantifying both.

An F et.al, (2011), in their paper, the objective is to provide an updated analysis on recent worldwide trends in vehicle fuel economy and GHG standards, identify best practices, and make recommendations for future policy making to ensure realistic, enforceable and agreeable mitigation strategies to reduce transportation energy use and associated GHG emissions in a cost-effective way. In spite of the recent financial crisis, global oil demand has steadily increased, largely due to rapid motorization taking place in developing countries, in particular in countries with rapidly growing economies, such as Brazil, China, India and others. Oil demand growth is primarily driven by growth in the vehicle population, especially private passenger vehicles, as well as total vehicle distance traveled. Controlling the energy demand and

greenhouse gas (GHG) emissions from personal vehicles has become a major challenge. Curbing vehicle population growth, reducing travel demand and improving vehicle fuel efficiency are three key elements to reducing overall oil demand. A wide variety of approaches to address these three areas have been introduced in different parts of the world. The United States was the first country to establish fuel economy standards for passenger vehicles after the 1970's oil crisis. Fuel economy programs include both numeric standards and fiscal incentives to improve the energy efficiency of individual vehicles per unit of distance traveled. In today's technology-driven world, new technologies offer great promise to drastically improve vehicle fuel economy. Realizing such technological promise is contingent on strong policy. Technology development also responds to price. Different countries and regions have chosen to adopt different fuel economy or GHG standards for various historic, cultural, and political reasons. Vehicle fuel economy standards can take many forms, including numeric standards based on vehicle fuel consumption, such as liters of gasoline per hundred kilometers of travel (L/100-km) or fuel economy, such as miles per gallon (mpg), or kilometers per liter (km/L). Automobile GHG emission standards are usually expressed as grams per kilometer (gCO2/km) or grams per mile (gCO2/mile). As vehicles become increasingly electrified, their emissions may begin to be regulated by other policies, such as those focusing on the electrical power sector. In

this case, new methods and standards for evaluating and regulating the energy efficiency of vehicles will be necessary. The number of private motor vehicles is growing at a pace never seen throughout history, in many cases in jurisdictions that do not have the know-how to measure, report and regulate on the efficiency of new or old technologies. It is essential that researchers and policy-makers cooperate to share and implement best practices, in order to promote the "greenest" technologies worldwide, and provide more assurance for a more energy and carbon-constrained world.

Agrawal P (2012), in his working paper estimates demand relations for crude oil, diesel and petrol for India for the period between 1970-71 and 2010-11 using the auto-regressive distributed lag(ARDL) co-integration procedure and uses these estimations to project demand for these products up to 2025 under various scenarios of GDP growth and oil prices. Estimations of crude oil demand and projections for the future should be useful to policy makers in making appropriate supply arrangements for the future. Out of India's total energy consumption, crude oil accounts for 24%, natural gas 6%, coal 40%, combustible renewable and waste 27%, hydro electric power 2%, and nuclear energy and wind energy about 1 each. Thus, crude oil and coal account for about two-thirds of India's energy consumption. Further, there are hardly any suitable alternatives to crude oil derivatives such as petrol and diesel for transportation purposes and most industrial machinery.

Thus, controlling crude oil consumption is difficult. The projections show that over 2011-2025, demand for crude oil is likely to increase by about 90%, for diesel by about 110% and for petrol by about 165% in the near future. The corresponding annual growth rates come to about are 4.7% for crude oil, 5.4% for diesel and 7.2% for petrol. In view of this importance of crude oil and other petroleum products in India's energy security and in the sustainability of its high growth rate, this study focuses on an empirical analysis of petroleum demand. Several studies on India use the ordinary least square (OLS) method (Goldar and Mukhopadhyay 1990, Rao and Parikh 1996; Parikh et.al, 2007), but results can be unreliable as most variable involved are actually non-stationary. Thus, to meet the growing demand for crude oil, diesel and petrol etc in the long run, India should take various measures for efficiently improvement in energy use. It also needs to enhance petroleum supplies through increased domestic explorations as well as other measures such as participation in exploration and production in foreign oil fields by Indian Oil companies to avoid excessive dependence on imported crude oil.

Gugloth S et.al, (2012), in their journal reveals that rural demand in automobile is growing at a faster rate than anticipated due to rise in its consumption patterns. Rural markets have a socio-economic role to play in rural economy as the agents of rural developments. The potentiality of rural markets is said to be like 'a woken up sleeping giant'. Three-fourth

of the country's consumer lives in rural areas and one half of the international income is generated there. India is the 2nd largest two-wheeler market in the world with a size of over Rs 100,000. Rural India provides a highly unexplored market for the expansion of retail activity. The penetration of the organized retail specifically is very low. Approximately, ten thousand out of six lakh villages in India have access to organized retail services. According to the Associated Chambers of Commerce and Industry of India (ASSOCHAM), the two wheeler penetration in villages is only 10% as compared to 25% in urban areas. High investment involved, poor conditions of rural roads, lack of finance facility, and lack of service network have limited the scope of passenger cars in countryside. In the last few years, the Indian two-wheeler industry has seen spectacular growth. The country stands next to China and Japan in terms of production and sales respectively. Majority of Indians, especially the youngsters prefer motorbikes rather than cars. Capturing a large share in the two-wheeler industry, bikes and scooters cover a major segment. The present scenario of rural marketing especially decision making process of purchasing two-wheeler in rural area, and its importance, current trends, and highlights certain problems related to rural marketing area. In this article study for the demand of two-wheelers in rural area and influence the factors like family, friends, dealers, service and mileage for the process of purchasing a two-wheeler. Rural market is not fully encased by marketers. Banks and

other financial institutions have an assortment of vehicle loan schemes with attractive rates of interest and convenient number of installments, it will give additional support to the automobile sector, to boost sales across various segments. Then only automobile companies could significantly increase their market share by extending attention on rural areas.

John S.M (2012), in his study shows that marketing strategy is often considered the most important means of establishing an opinion about a brand. Over the years, a large number of studies in consumer behavior have exported various broad theoretical constructs to explain consumer behavior and how various elements in these models affect brand opinions. This study combines the established models of consumer behavior to examine the relationship between the various elements and brand opinion for fuel brands in the Indian fuel market. Opinions about brands come from the current or potential consumer learning which influences how the product is encoded and acted upon by consumers. It stands to reason that such learning is dynamic and influences consumer opinion process and outcomes, either directly or indirectly, by being influenced through the effectiveness of branded fuel's communication about the differences. This work considers consumer's opinion about the various brands of fuel as an outcome of the relationships between the various elements that make up the model of consumer behavior for fuel brands. These relationships result in

attitude formation towards a brand of fuel which in turn results in a particular opinion about the brand. The fuel filling station intercept survey was conducted to collect respondent data across 15 zones throughout Chennai city. A total of 302 consumers comprising of 151 two wheeler users and 151 four wheeler users were contacted. 200 valid responses comprising of 100 two wheeler users and 100 four wheeler users were received. Structural Equation model was used as the tool for analysis. The results showed that- Of the eight determinants considered, some had a very strong impact on attitude formation because they positively impacted the dimension considered for the study i.e, opinion about a brand of fuel, Foreign brands and promotions done by Oil Marketing Companies did not impact opinions about fuel brands for such consumers, experience and word of mouth is a better determinant of Brand opinions, repeat purchase and patronage of a fuel filling station. Geographical limitation of the sample and conspicuous quality differences among the various brands of fuel were identified as some of the key limitations of the study.

Mitran G et.al, (2012), in their paperwork presents that air pollution is a consequence of human activities, including the road vehicle use. Thus, transport, especially road traffic, is a major source of air pollution in most of the world. Road traffic associated air pollution comes mainly from burning fossil fuels. In order to improve the air quality at local level and to propose traffic management strategies, it is

necessary to investigate the relationship between traffic flow, emissions of pollutants and their dispersion in the atmosphere, as well as their potential impact on operational processes of the network and of the traffic management. This paperwork presents the main methods for estimating air pollution from road traffic, corresponding to different levels of detailing of road traffic modeling (macroscopic, mesoscopic and microscopic levels). Since the last century, as a consequence of advanced industrialization and remarkable growth of population and its mobility needs, particularly in urban areas, air pollution attributable to anthropogenic activities has accused more acute forms and often irreversible. There was a continuous accumulation of various pollutants in the environment, with increasingly severe consequences on humans, animals and plants, buildings, works of art and landscape in general. The road transport has become a common and necessary component of everyday life. Despite its value, flexibility and necessary as parts of modern society, the road transport is recognized as having a major contribution to undesirable environmental problems. The transport sector, especially road traffic, constitutes a major source of pollutant emissions. This paperwork presents the main methods for estimating air pollution from road traffic, corresponding to different levels of detailing of road traffic modeling. Air pollution is a consequence of human activities, including road vehicle use. Thus, transport, especially road traffic, is a major source of air pollution in most of the world. Road

traffic associated air pollution comes mainly from burning fossil fuels. The general process of modeling air pollution generated by road traffic consists of the following steps: *(i)* collecting data and information underlying the trips generation, *(ii)* estimating the transport demand and the affecting of the traffic flows on the entire analyzed network and *(iii)* the inventory of the emissions from road vehicles which compose the traffic flows. In the research in the field of transport, traffic flow representation was a key issue in modeling of air pollution from road traffic. Currently, the most used models to represent traffic flow are macroscopic models, which may show the average travel speed along a stretch of road. The data required in macroscopic modeling are moderate and can be easily applied to evaluate a wide range of transport strategies. But these models are not able to reveal the local variations concerning air pollution in the vicinity of intersections or in different traffic conditions. To overcome this shortcoming, mesoscopic models have been developed. Although these are essentially based on a macroscopic representation of traffic flows, they can describe different modes of using vehicles such as acceleration, deceleration, cruising and queuing. As a result, the mesoscopic models may be useful in modeling air pollution in the intersections area of influence. Therefore, special attention in the modeling of air pollution generated by road traffic is dedicated to developing models that are able to detail the traffic flow characteristics, namely the micro-simulation models. These models

have the ability to characterize the movement of each vehicle in terms of developed instant speed and acceleration. The emissions associated with traffic flow are obtained by aggregating the specific vehicle emissions at the individual level.

Rodrigues L.R et.al, (2012), in their paper deals with the development of a system dynamics model to simulate the rise in fuel consumption in a district in India. The main aim of the paper is to study the influence of dynamic factors: Population, Fuel prices, Gross domestic product (GDP) growth, and Segment wise increase in fuel consumption. The model is used to simulate the fuel requirements for the two decades from 2011. The simulation results have aided the formulation of policies to check the rising fuel consumption, based on the projected figures. Although the input parameters are at the regional level, the influence of the before mentioned factors can be generalized to the global level. The world today is facing an extreme crude oil crisis. Petroleum products in the primary form are largely consumed for transportation and industrial purposes. Fuel crisis is one of the major crises to be managed in the years to come. History has witnessed its first major oil crisis in 1973, which was caused by major Arab oil producing states in response to western support of Israel during the Yom Kippur war. This was followed by the crisis caused by the Iranian war during 1979. The 1990 witnessed the price shock caused by the Gulf war. While the study of alternative fuels is emerging as one stream of interest

as a part of crisis management, scenario planning for the consumption of petroleum based fuels is a continuous endeavor as a separate stream. The two major consumers of petroleum based fuels are electricity plants and transport vehicles. It has been found that the supply of fuel is much lesser than the demand for it due to several factors the major being increase in global population. Hence, the general prediction is that the increase in the demand may finally result in a crisis leading to an emergency, which needs to be prevented through proper planning well in advance. The research methodology adopted in this paper goes in accordance to the principles of system dynamics methodology. At the current rate of increase in population, petroleum based fuel consumption is going to be exponentially increased over the next two decades in direct proportion to the increase in GDP, despite the increase in its price. A small increase in the GDP may not have a drastic increase in fuel consumption but a higher rate of increase in GDP, say 10 to 11%, the fuel consumption is sure to increase significantly. Rate of increase in fuel price will decrease the fuel consumption. Even a small increase in rate of increase of fuel price, say 1.5% may result in a decrease of about 25 Ml/year of fuel consumption. The system dynamics model developed in this research gives immense scope for future researchers to delve into the intricacies and criticality of influencing factors on fuel consumption to extend the model to the next level. One immediate consideration in

this direction could be the inclusion of the influence of renewable energy usage and the influence of innovative technologies.

Eriksson M et.al, (2013), in their study reviewed the available literature regarding greenhouse gas (GHG) emissions and energy balances in petrol and diesel use and examined possible causes for the differences reported in the literature. This included differences connected to the LCA methodology itself, but also those resulting from technical and economic effects. This is a case study that includes data from five refineries, located in Denmark, Sweden and Finland, that produce diesel of European standard (EN 590) and Swedish environmental standard (MK1) for the Swedish market. It describes the WTT chain with production of crude oil, transportation, processing and distribution to filling stations, but any transformation at source is excluded. Results from the study show that there are only small differences between MK1 and EN 590 diesel. However, the differences between the refineries are much larger and therefore introduce a possible bias in the results. The study includes a scenario where the production is targeted towards the global market instead of the Swedish market. This scenario gives small differences from the main result, since the only difference is that the MK1 diesel is assumed to be blended into the EN 590 diesel, since MK1 is a Swedish standard and therefore cannot be sold on the global market. This slightly decreases the emissions from EN 590 diesel. In this study the Portuguese transport sector is

investigated using life cycle assessments for different scenarios. The current situation of fossil fuels is calculated using the GREET model for analysis of the cradle-to-grave of materials. Many life cycle assessment (LCA) studies have investigated the environmental impact of using bio-fuel in transportation compared with fossil fuels. Since these studies often use standard values for the fossil fuel reference scenario, there is a need for a thorough review of published data on fossil fuel use in transportation. The variations in results in the 13 studies reviewed here can be explained by variations in the natural and techno-economic systems (e.g. origin of crude oil, venting and flaring, refinery technology) or by the usage of different input data and assumptions in the LCA (e.g. allocations, conversion factors, model usage, system boundaries). However, the results did not vary widely, since most of the GHG emissions are due to actual use of the fuel in vehicles. Another reason why the results from the studies did not vary more widely is that they are all based on average values and often use the same assumptions for uncertain data, which gives the extreme values less impact. This is the main reason why studies of the Swedish perspective often report lower values of emissions than the European average. All studies reviewed report higher values for GHG emissions than the standard value used in the EU Renewable Energy Directive. This could lead to an unfavorable situation for bio-fuels when they are compared against an unexpectedly low value for fossil fuels.

Iqbal M et.al, (2013), in their journal includes comparison study of battery operated easy bike with CNG (Compressed Natural Gas) operated auto rickshaw in terms of cost (operating cost, manufacturing cost, maintenance cost), user friendly and environmental issue. Auto rickshaws are tiny, three-wheeled vehicles which are used extensively in many Asian countries for transport of people and goods. The vehicles are small and narrow allowing for easy maneuverability in congested Asian metropolises. In Bangladesh, auto rickshaws are commonly used as taxis. This is due to the use of an engine, typically a 2 or 4 stroke, with almost no pollution control. Usually fuels are used in auto rickshaws. But a few years ago some auto rickshaws have been imported from china which is run by battery. The numbers of battery powered auto rickshaws are increasing day by day. Most of the cities in developing countries are highly polluted. The main reasons are air and noise pollution caused by transport vehicles, especially petrol-powered two and three wheelers. Alternative energy solutions received a great deal of attention in the last decade due to the need of sustainable and environmental friendly energy sources. The main pollutant source in urban areas is the emission of vehicles with ICE (Internal Combustion Engine). Increased concerns over global and local pollution, depletion of fossil fuels, and higher gas prices have motivated ambitious plans for new vehicle types with alternative energy sources. Hybrid electrical vehicles that combine the advantages of two power sources, ICE and

electrical motors, have been the focus of attention recently. A two or four stroke gasoline engine usually powers these vehicles. In recent years, alternatives such as CNG and LPG (Liquefied Petroleum Gas) models have been introduced to deal with the pollution problem. While these vehicles reduce the amount of particulate matter and other harmful pollutants they do not eliminate them and cities where rickshaws are numerous will continue to have poor air quality. The capital city of Bangladesh is one of the most polluted cities in the world although the majority of the public transport is currently based on the CNG technology. From the study of Battery operated Easy Bike and CNG operated Auto Rickshaw in terms of cost it is seen that the manufacturing cost and Maintenance cost are little bit higher for CNG operated Auto Rickshaw than that of Battery operated Easy Bike because of complex structure of CNG operated Auto Rickshaw. It is found that CNG operated Auto Rickshaw is more comfortable than the Battery operated Easy Bike for its better sitting arrangement. The sitting arrangement of Battery operated Easy bike is not acceptable and clumsy and the sitting capacity of the passenger is more than the actual. This makes the transport to move slowly. From the mechanical point of view, CNG operated Auto Rickshaw consist better Braking system, controlling power and steering than the Battery operated Easy Bike. For the safety purpose CNG powered Auto rickshaw is safer than then Battery powered Easy bike, because of better lighting system. CNG

powered Auto rickshaw driver are more efficient than the Battery powered Easy bike because of their training facilities. From the driver and the passenger point of view both of them like the CNG powered Auto rickshaw. From their comments it is assumed that the CNG powered Auto rickshaw are better transport system in our country. For the environment issue, Battery operated Easy Bike is more environment friendly than the CNG operated Auto Rickshaw when at running condition. But the battery of Battery operated Easy Bike is not environment friendly, because the battery is dumped in open space. As battery contains harmful chemical known as lead-acid battery. This makes the land polluted and as well as the air. Further such research is required in other cities of Bangladesh where those two transports are used popularly.

Tiwari K.P et.al, (2013), studies different traffic signal squares of Indore. The selected traffic signal crossings were Palasia Main, Palasia-1st signal crossing, Gurudwara signal crossing, Bangali signal crossing, Bhowarkua signal crossing, regal signal crossing, and Mhownaka signal crossing. Among the different city of Madhya Pradesh, Indore is one of the biggest one. It has very heavy traffic during day time. Since numbers of vehicles are increasing day by day, which ultimately increase the length of stopping period of vehicles at most of the signal?. Situation becomes worst in peak traffic hours. Resulting excess fuel consumption and pollution load to the atmosphere. Vehicular pollution and fuel

wastage is directly or indirectly linked with the population. Due to increasing population, numbers of vehicles are increasing, which results in increasing fuel consumption. This is also responsible for road traffic problems. Increasing traffic problems not only responsible for degrading of our atmosphere, it is also responsible for wastage of fuels. Traffic signals have become an invaluable tool in ensuring smooth flow of motor vehicles at crossings. Consequently, with orderly flow of traffic, we lose huge quantity of fuel at crossings and creating the pollution for already polluted environment. This is because people often leave the engine of their vehicle running while waiting at signals (Idling). During no load running mode (idling) of the vehicular engine, the air supply is restricted by the nearly closed throttle and the suction pressure is very low. This low pressure condition gives rise to backflow of exhaust pressure, results an increase the amount of residual gases and reducing the fresh mixture inhaled. Idling increases dilution causes the combustion to be erratic, irregular and slow, so obtained, results in poor thermal efficiency and higher exhaust emission. At part load and idling the compression ignition engine presents even more favorable relative fuel consumption than the spark ignition engine. At idle condition, engine speed gets increases. Engine speed badly affects the environment too. Research results obtained have shown about 5.9 x 105 litre per year petrol plus diesel (3.6 x105 litre from petrol and 2.3 x 105 litre from diesel) and 1.7x105 kg per year of CNG are being wasted by Indore city

and it is adding about 6.4 x 105 kg CO2 from diesel, 8.5 x 105 kg CO2 from petrol and 5.3 x 105kg CO2 from CNG to the already degraded atmosphere every year. In case of state level (Madhya Pradesh) fuel wastage estimated as 5.6 x 106 litre / year from petrol plus diesel (3.4 x 106 litre from petrol and 2.2 x 106 litre from diesel) whereas 1.6 x 106 kg/year from CNG and CO2 emission from petrol approx. 7.9 x 106 kg/year, from diesel 5.9 x 106 kg/year CO2 and from CNG 4.9 x 106 kg/year CO2 emissions. Basically, it is a study survey on quantification of fuel wastage during idling of vehicles at traffic signals, assessment of total fuel wastage during idling of vehicles at traffic signals and guesstimate of benefits in terms of fuel savings to be accrued by implementing improvement measures at the state level. However, on the basis of this method it could be find out the quantification of fuel wastage during idling of vehicles at traffic signals, assessment of total fuel wastage during idling of vehicles at traffic signals for country level or global. It would be helpful in saving the large extent of fuel on global level. The extra fuel consumption at the traffic signals is much higher because of the irresponsible behaviour of the driver/rider and lack of determination towards stopping the wastage of fuel, on the basis of observations it is suggested that rider should OFF engine while waiting for green signals. There is a need of awareness among the people about increment of emissions during due to idle engine and to take care of it this emission, government should take proper action and provide laws,

rules and regulation and follow it strictly. Mileage of a vehicle depends on the driver's habit. Smoother and controlled driving results better with mileage of vehicle. Driving habits, also much affect the traffic flow. So, the driving should be smooth, stream-line and constant spacing between the adjacent vehicles.

Ankalikar A et.al, (2014), in their journal, India is highly dependent on imported energy specially the crude. Indian transportation sector is heavy consumer of motor spirit and high speed diesel oil. This paper analyses the import export gap in petroleum products, the consumption patterns of Indian transportation sector as well as exploring means of minimizing wasteful consumption of valuable energy. As part of analysis, the losses in automobiles such as engine losses, transmission losses as well as friction losses are analyzed. Factors which pertain to driving behavior and condition of the vehicles are vital for minimizing consumption. A recommendation is made for eliminating wasteful consumption due to frictional losses such as low tire pressure, idling losses etc., through a framework of sensors and On Board Computer and Diagnostics and vehicle to infrastructure communication system which can monitor and recommend ideal driving behavior resulting in savings in imports of crude. The savings based on the data available is worked out and presented as study findings. The Indian economy is at a critical stage of development. It loses enormous amount of foreign exchange on importing petroleum products. It is important to know that the country's

precious foreign exchange reserves get consumed just on POL imports which are staggering 32.97% of total imports of the country. India is a highly import dependent country especially as just about 30% of the country's energy needs are met by indigenous reserves. India's automobile and vehicle driving behaviors is not eco-friendly neither does the same help in minimizing imports. There are several possible options technology provides and based on some simple measures such as motor idling, tire pressure, smart driving the savings could be over INR 2135 crores annually. Government of India through its Gazette provides guidance on the use of vehicles based on contemporary technologies. It is recommended that as use of On Board Computer and Diagnostics can help reduce the consumption of fuel, in turn providing savings to the national exchequer of imports of crude of equivalent amount.

Chandra I (2014), in his research paper, with the help of quantitative data seeks to identify the factors and segregate such factors that are responsible for the Indian middle class buyer to migrate from one car to another while purchasing their next vehicle. With the help of secondary data, the set of government five year plans (10th Five Year Plans and 11th Five Year Plans) sprang into action and there successful attainment of their objectives such as, creating 70 million new work opportunities, increasing wage of unskilled labor by 20% and reducing unemployment of educated individuals less than 5%, increase literacy

rate by 85% and providing broadband connectivity to all villages in the country. These factors have been greatly responsible for both progress of the Indian middle class as well evolution of their consumption behavior. Primary data concluded that the two most popular car brands amongst Indian consumers were Maruti Suzuki (owned by 32.4% of respondents) and Hyundai (owned by 28.8% of respondents). Analysis of primary data also showed that even after continuous increase in fuel prices, the priciest fuel petrol still remained this most popular fuel and was followed by diesel. The newly introduced fuels CNG and LPG were found to be fast growing but only 2 respondents used a car powered by Hybrid system. Therefore it should be concluded that only a negligible amount of people use cars powered by hybrid system. Primary data also showed that 75.6% of the respondents preferred foreign car brands like Suzuki and Hyundai over indigenous car brands like Tata and Mahindra. This finding falls in harmony with the two most popular car brands owned by the Indian middle class as discussed above (Maruti Suzuki being Japanese and Hyundai being Korean). An interesting trend that was discovered by the collection of primary data was that not even 50% of Indian middle class conduct an extensive research while purchasing a car which is interesting as a car purchase comprises of a substantial percentage of Indian middle class families disposable income, yet most of the households are mainstream followers and they turn to opinion leaders and highest selling product to guide them through the purchase

decision. By the analysis of primary data it was discovered that the strongest reason for consumer's migration from one manufacturer to another was fuel consumption (achieved a correlation value of 0.808). The second strongest factor causing consumer's migration of brands was financing. In-house financing or/and ease of financing was the second strongest cause of consumer's switching car manufacturer.

Mathew T.V (2014), in his study attempt to provide a basic knowledge about the fuel consumption and vehicular emissions. The concepts of air pollution and automobile pollution are also given due importance. Various types of numerical models related to fuel consumption and air pollution are discussed briefly. The report aims to identify the necessity of understanding the impact of vehicular pollution on the environment. In order to bring the fuel consumption and emission levels to a minimum, various mitigation measures are to be implemented, which are also pointed out in the report. Urbanization has paved the way for higher levels of comfort and standard of living. Rapid urbanization has thus caused an increase in the number of vehicles and this, on the other hand, is causing another set of problems including lack of space, reduction in natural resources, environmental pollution, etc. For this, a basic knowledge about fuel consumption, emission and resulting air pollution is required. Fuel efficiency or Fuel Economy is the energy efficiency of a vehicle, expressed as the ratio of distance traveled per unit of fuel consumed in km/liter. Fuel efficiency depends

on many parameters of a vehicle, including its engine parameters, aerodynamic drag, weight, and rolling resistance. Higher the value of fuel efficiency, the more economical a vehicle is (i.e., the more distance it can travel with a certain volume of fuel). Fuel efficiency also affects the emissions from the vehicles. Fuel consumption is the reciprocal of Fuel Efficiency. Hence, it may be defined as the amount of fuel used per unit distance, expressed in liters/100km. Lower is the value of fuel consumption, more economical is the vehicle. That is less amount of fuel will be used to travel a certain distance. Air pollution has become a major concern in most of the countries of the world. It is responsible for causing respiratory diseases, cancers and serious other ailments. Besides the health effects, air pollution also contributes to high economic losses. Poor ambient air quality is a major concern, mostly in urban areas. Air pollution is also responsible for serious phenomena such as acid rain and global warming. The substances causing air pollution are collectively known as air pollutants. The pollution caused due to the emissions from vehicles is generally referred to as automobile pollution. The transportation sector is the major contributor to air pollution. Vehicular emissions are of particular concerns, since these are ground level sources and hence have the maximum impact on the general population. The rapid increase in urban population have resulted in unplanned urban development, increase in consumption patterns and higher demands for transport and energy sources, which all lead to automobile pollution.

The automobile pollution will be higher in congested urban areas. The vehicle obtains its power by burning the fuel. The automobile pollution is majorly caused due to this combustion, which form the exhaust emissions, as well as, due to the evaporation of the fuel itself. Automobiles are large contributor to the environmental pollution. The different fuel consumption and air pollution models discussed in this report help us to estimate how much fuel we are using and the amount of pollutants we are releasing in the atmosphere. As the population and number of vehicles are increasing abruptly, more amounts of pollutants are being discharged. If this trend continues, there will not be any more energy sources left for the future generations. Also, the world will be so polluted that living organisms may not be able to thrive. Hence, we need to understand the importance of saving the environment. Alternate sources of fuels for e.g. renewable sources can be used which also help in reducing the pollution. Our aim must be to preserve the nature and have the environment, along with a sustainable transportation system.

Mohan D et.al, (2014), in their paper, a combination of primary surveys has been utilized as well as secondary sources available in the public domain of the cities. For Delhi, Visakhapatnam and Rajkot, the results are presented from the fuel station surveys. Moreover, for Delhi, results from the pollution check centre database are also presented. Globally, fuel efficiency of vehicles is taking centre stage within the context of climate change, public health, and reducing dependence on

oil. In India, efforts are underway to formulate fuel efficiency standards for cars. In this regard, this report gives an account of fuel efficiency and other vehicular characteristics of the existing fleet in India. Globally, fuel efficiency of vehicles is taking centre stage within the context of climate change, public health, and reducing dependence on oil. In India, efforts are underway to formulate fuel efficiency standards for cars. In this regard, this report gives an account of fuel efficiency and other vehicular characteristics of the existing fleet in India. This information forms an integral part of understanding the status of the current fleet, as a base case. This report presents case studies of three cities in India – Delhi (the capital city), Visakhapatnam in Andhra Pradesh, and Rajkot in Gujarat. Vehicular characteristics estimated include age distribution, annual mileage driven and number of in-use vehicles. A high growth rate of vehicles in Indian cities with a comparatively smaller existing fleet means that fuel efficiency standards will have their desired effect at a much faster rate than most developed economies of the world. It is estimated that fuel standards, when implemented in India, will lead to 90%of vehicles conforming to those standards within the next 15 years. Various studies from different parts of the world (none available from India) have found a wide gap between the real-world and laboratory-based values of fuel efficiency of vehicles. The reported gap reaches up to 30%of the real-world value. With such a gap, the use of laboratory-based values, provided by auto manufacturers

to estimate the baseline fuel efficiency of vehicular fleet, will overestimate the actual fuel efficiency. Therefore, there is an urgent need to carry out user surveys in Indian cities, in order to take stock of the current fleet – in terms of fuel efficiency and vehicle usage. While most countries have studies quantifying the gap, efforts in this direction are pending in India. In order to be able to ascertain efficacy of standards, these efforts need to be carried out and repeated at regular intervals. Technological advances for internal combustion engines are promising to bring about a significant change in the fuel efficiency of vehicles in the near future.

Murugan M.S et.al, (2014), in their journal studies the women consumer awareness, preferences and purchase decision of two wheeler in metro cities like Chennai, Mumbai,Delhi and Kolkata. Consumers make decision regarding the choice, purchase, use of products and services. They face a lot of dilemma at the time of taking a purchase decision. Thus, a decision is a process by which the consumers identify their needs, collect information, evaluate alternatives and make purchase decision. These decisions are useful to both marketers and policy makers. This study throws light on the perception of women consumers towards the purchase decision of two wheelers in India. Today, the two wheelers industry plays a significant role in the Indian economy. India is the second largest two wheeler market in the world, fourth largest commercial vehicle market in the world, and 11th largest passenger car

market in the world and is expected to become the 7th largest by 2016. (source: Society of India Automobile Manufacture, SIAM). Women play a significant role in the domestic and socio-economic life in the society. In India, over the years, both female and male roles have been changing. Now a day's, women are playing different role of chief purchasing officer and controlling 85% of buying decisions. Certainly, in male dominated societies many goods and services are actually decided and purchased by women. This is due to increasing literacy, independent income and role in the family. Significantly, the two-wheeler has become a valuable support for them to increase their income, besides personal transportation. Evidently, during 2007-08, the scooter segment grew by 11% in the year 2007-08. The industry sold more gearless scooters (Business standard, 2013). So many companies are targeting women to boost their two wheeler sales. Hence it is necessary to study the perception of women consumers regarding the purchase of two-wheeler. This study helps the two wheeler companies to chalk out their strategies to enlarge their market share and enhance the level of awareness among women consumers. Therefore, it was found that regions have strong influence on the preference, attitude, decision making and satisfaction of women towards two wheelers in India. Other factors such as promotional schemes, performance, utilitarian benefits, personal factors and value added benefits were perceived by women consumers in four cities as more important than regions. Thus, the

overall findings of the study provide implications for marketers and manufacturers of women two wheelers.

Pai M et.al, (2014), in their working paper draws attention to the important and underexplored issue of motorized two-wheelers, a ubiquitous transport mode in growing Indian cities. On one hand, motorized two-wheelers present a challenge because of the serious safety concerns and dependence on personal motorized vehicles that they engender. Currently cars constitute just over 13 percent of the vehicle population in India, while two-wheelers constitute more than 70 percent. The key objective of this study is therefore, to better understand the role of motorized two-wheelers in urban transport, the mobility advantages they offer, the challenges they present, and possible policy options to manage them. The authors conducted a thorough review of the literature on urban two-wheelers in Asia and India in particular, a case study of the city of Pune in India, and a review of experiences from cities like Taipei, Taiwan that have implemented successful policies to manage two-wheelers. The paper discusses the effect of two-wheelers on motorization in Asia and India, key factors influencing two-wheeler ownership and use, economic and demographic characteristics of two-wheeler users, their usage patterns and propensity to shift to alternate modes of transport. The findings show that affordability and convenience offered by two-wheelers have made them a hugely popular mode of transport in Indian cities, a trend significantly advanced by the

lack of adequate and good quality public transport systems and non-motorized transport infrastructure in many cities. Data from the Pune survey suggests that the use of two-wheelers can engender a lifelong preference for private motorized mobility, with 80 percent of surveyed two-wheeler users stating that they would be interested in purchasing a car in the future. With the national government supporting the growth of the automotive industry, the market share of private motorized vehicles (cars and two-wheelers) appears set to grow. Significantly, two-thirds of the two-wheeler riders surveyed in Pune said they used public transportation prior to using two-wheelers. Large metros like Delhi, Kolkata and Mumbai with higher public transport shares have low two-wheeler shares, while the converse is true in the case of small to mid-sized cities like Ahmedabad and Pune, which have the highest two-wheelers shares in the country. Some key factors influencing two-wheeler ownership and use in Asian cities are their low costs and fuel economy, maneuverability and ease of parking in congested conditions, shorter distances or trip lengths and low levels of transit services, walking and cycling infrastructure. In Pune, comfort, convenience and enjoyment were the top reasons given by surveyed riders for starting to use motorized two-wheelers. While fuel price thresholds for shifting to alternate modes of transport were fairly inelastic, nearly 80 percent of the surveyed two-wheeler users said they would be willing to shift to public transport if services were improved. An interesting finding was

that about 27 percent of the surveyed riders used the two-wheeler in conjunction with another mode of transportation on a single trip, primarily bus and auto-rickshaws, pointing to the potential for integrating two-wheelers with other public transport modes. The Pune survey also provided interesting insights on the demographics and income distribution of two-wheeler users. It was seen that men primarily used two-wheelers to travel to work, while more women used them to access education or for recreation/shopping trips. This perhaps shows the opportunities provided by the mode to women, for whom the unreliability of public transportation may be a more significant problem than for men for reasons of safety and household responsibilities. Safety with respect to two-wheelers is considered a significant concern. Recent data showed that the highest number of road fatalities in India was two-wheeler riders and the country records the maximum number of deaths from motorized two-wheeler accidents in the world. In Pune, 50 percent of the traffic accident-related fatalities in 2010-11 were two-wheeler riders, and of the surveyed two-wheeler riders, about 20 percent had been in an accident before. The survey also found that all respondents with children owned a two-wheeler, while a third of them also owned a car. Data also revealed that two-wheeler ownership and use was not limited to lower income populations as is normally perceived. Across Asian countries, policies on two-wheelers have typically been lax due to the presumed vulnerable nature of the user (i.e., low income), and this

may not be relevant because many two-wheeler users can afford to pay the full costs of their ownership and use. However, a number of the stakeholders interviewed in Pune felt that charging the real costs of resources used by two-wheelers and the negative externalities they cause - which may include higher taxes and fuel prices, congestion and parking fees - would be politically difficult to implement for fear of public backlash.

Shende V (2014), in his journal reveals that the automobile industry today is the most lucrative industry. Due to increase in disposable income in both rural and urban sector and availability of easy finance are the main drivers of high volume car segments. Further competition is heating up with host of new players coming in and global brands like Porsche, Bentley, and Ferrari all set to venture in Indian market. This research will be helpful for the existing and new entrant car manufacturing companies in India to find out the customer expectations and their market offerings. Indian Automobile car business is influenced by the presence of many national and multinational manufacturers. This paper presents analysis of research in the area of Consumer Behavior of Automobile Car Customer. Proper understanding of consumer buying behavior will help the marketer to succeed in the market. All segments in Indian Car industry were studied and found that buyer has different priority of behaviors in each segment, where as main driver for car purchase is disposable income. Value for money, safety and driving

comforts top the rank in terms of customer requirement; whereas perceived quality by customers mainly depends on brand image. For this research, methodology adopted was to study the research papers in the area of Passenger Car segment, study the purchase decision process and its interaction with behavior parameters across all the segments of car such as small & Hatch Back segment, Sedan class segment, SUV & MUV segment and Luxury Car segment. The objective of this study is the identification of factors influencing customer's preferences for particular segment of cars. This paper also attempts to consolidate findings & suggestions to overcome present scenario of stagnancy in sales and cultivate future demand for automobile car market. India being the second most populated country in the world and the growth rate of Indian economy is also high as compared to developed countries, which attracts the presence of huge demand in the Automobile Small Car Industry. India is becoming emerging market for worldwide auto giants. It is only through research that a company will be able to study the buying behavior of consumers. With better understanding of customer's perceptions, companies can determine the actions required to meet the customer's need. They can identify their own strengths and weaknesses, where they stand in comparison to their competitors, chart out the future progress path and improvement. The passenger car market changed very rapidly due to the fierce competition and advance technology, therefore, it requires the automotive manufactures to understand the consumer's

preference on time and take fast actions to reflect market changes quickly. So it would be very interesting to know consumer's preference in today's fast-changing passenger car market and how is the customer's buying process. In this paper an attempt is made to- Study & Classify Car market based on segments like – small car, Hatch back, Sedan Class, premium Sedan, SUV & MUV and Luxury Car, study on purchase decision process. Broad classification of behaviors and their effect on various car segments. Consumer behavior consists of all human behavior that goes in making before and post purchase decisions. One can succeed in the competitive market only after understanding the complex consumer behavior. An understanding of the consumer enables a marketer to take marketing decisions which are compatible with its consumer needs. From study there are various major classes of consumer behavior determinants and expectations, namely socioeconomic, psychological, political, geographical, demographic and Product & Technology. Further classification of human behaviors under main categories will enable car manufacturer to align their strategies in concurrence to customer behavior. While purchasing mini segment car though customer is highly cost conscious but this segment is also upgrading their requirements and due to rise in disposable income, with in segment migration is observed, Customer is more inclined to purchase Suzuki Swift, 120. For mid size segment customer focus is for safety, driving & seating comfort, brand. Also this segment requires

value for money, best features and customer friendly vehicles. In higher segment cars like Executive and Premium brand image is main deciding factor which gives assurance of meeting their needs in terms of safety, performance and feature requirements. Global brands are highly preferred in Executive and above segments. So car companies should adopt the "Think-Global, Act-Global". Approach in strategy making which involves standardization across the world. Brand global presence is judged by consumers based on availability around the globe with standardized products, brand name, distribution channels and communications. By going global, the company will enjoy an increase in market share, which indicates increase in demand for their products. With that, the company can produce with economies of scale, reduce cost per unit and increase production efficiency resulting in serving customers efficiently and economically. Most importantly, compared to local brands, companies with global brands will be able to penetrate into markets more easily, regardless to high or low status seeking consumers, global brands with proper strategy will enable them to achieve an enhanced global image.

Srinivasan V et.al, (2014), in their study concerns the use of alternate fuels for automobiles. Since the automobiles are the main source of transportation, its usage increases day by day. Thereby it is necessary to identify a cheaper fuel for it. The currently existing and widely used fuel named gasoline also called as petrol. The cost of this

fuel day by day increases and also it will be exhausted in future after some years. Another problem currently using fuels are the exhaust. The exhaust consists of NOx, CO, CO2, SOx, lead and other particulates which lead to air pollution and adverse affect on human beings. So it is important to opt for alternate fuels, which are cheaper and less pollutant to environment. Currently, motor vehicles are estimated to contribute about 14% of the global CO2 emissions, 50-60% of the CO, Hcs and lead, 30% of the Nox and about 10-20% of the particulate emissions (Faiz 1993) . The pervasiveness of the automobile (like many other developments of economically feasible fuel production technological marvels of the 20th century) is closely linked to global "development." As a result, even though car ownership in the industrialized nations is approaching saturation levels, the relative numbers of cars are much lower in most of the lesser industrialized countries (LICs) or newly industrialized countries (NICs). A commonly discussed approach to severely curtail or eliminate the emissions of carbon dioxide (the primary greenhouse gas) is to switch to alternative sources of fuel (or energy) for powering automobiles on a large scale. This article seeks to examine the feasibility and effectiveness of such an approach, especially in terms of its large scale implementation. Successful widespread use of alternative fuels is contingent upon the development of automotive technology that allows their use, as well as the development of economically feasible fuel production technologies. Toward this end, the

possible automotive technologies based on non-conventional fuels or energy sources that could mitigate greenhouse emissions, as well as the possible sources for these alternative fuels, are discussed. Also discussed are some of the environmental, social and economic issues that become relevant as the large-scale use of alternative fuels is considered. Finally, adopting a broader perspective, other options and policy instruments that might be useful in mitigating the greenhouse impact of the transport sector are also discussed in some detail. The aim of this study, then, is to attempt to clarify the ethanol enrichment debate, by examining the entirety of this topic, with particular attention to issues. The study mainly concerns environmental impacts, based on a comprehensive review of the peer-reviewed technical literature since the mid-1980s and many governments of privately commissioned research agency and company reports. This study examines the ethanol enrichment of unleaded gasoline, with specific attention to air pollutant emissions, sub-surface impacts, greenhouse gas emissions, energy efficiency and sustainability. The sustainability of ethanol production is affected by generous producer and agricultural subsidies, trade barriers and the need for agricultural expansion and genetic engineering. Yje proper proportion of ethanol with gasoline leads to the increase in fuel efficiency and also considerable reduction in harmful exhaust gasses. Since the cost of ethanol is much less as compared to gasoline, a complete research is required for accepting it as an alternative fuel.

Supe V.N et.al, (2014), in their journal analyses the carbon emissions reduction goals for vehicle fleet. The micro-hybrid (start-stop) system is based on an intelligent combustion of engine, breaks and battery management. This system automatically sheets down and restarts the internal-combustion engine to reduce the amount of time the engine spends idling in traffic jam, traffic signal or when people chat keeping the vehicle on (idle condition). When the traffic jam is over or traffic signal is released or the chatting of two drivers is finished as the driver raises the accelerator, the system automatically restarts the engine. The-micro hybrid systems are also known as start-stop systems and stop-go systems. This system is most advantageous for the vehicles which spend significant amount of time waiting at the traffic light or frequently come to stop in traffic jam. The electronics ensures the fuel saving, reducing CO2 emission and ultimately conserving nature without compromising convenience. For the non-electric vehicle (called micro hybrid) fuel economy gained from this technology is typically in the range of 5 to 10 percent. This micro-hybrid technology is proposed in two wheelers and affordable cost. This is because in the urban area the popularity of two wheelers is increasing day by day. The objective of this system is to help to conserve fuel, nature, money and to generate revenue by converting this system in to the successful product. This stop-start vehicle can offer significant reductions in fuel consumption and CO2 emissions, although the actual saving depends heavily on the drive cycle. Stop-start vehicles

require more robust batteries and starter systems than are found in internal combustion engine vehicles and are priced at a small premium over ICE's but considerably less than hybrid vehicles. With the most aggressive environmental goals in the world, Europe has been so far the greatest selection of vehicles with stop-start technology and not surprisingly, the greatest volume of vehicles (cars) sold. This system raises the alarm to the society to cut CO2 emission, save fuel and preserve the nature as well as solution to the mentioned issues. This is very cost-effective system useful in two wheelers to save fuel, CO2 emission, nature and global warming.

Yuvaraju D et.al, (2014), in their journal the two wheeler industry has been going steadily over the years all over the world. India is not an exception for that. Today India is the second largest manufactures of two wheelers in the world. It stands next only to Japan and China in terms of number of two wheelers produced and sold. Until 1990 geared scooters dominated the two wheelers market so much so that their sales equaled the combined sales of Motor cycles and Mopeds. Today the customer preferences have shifted from geared scooters to motorcycles and also to an extent to the premium end scooters. With rising fuel cost and more recently stringent emission norms imposed by the government, there is a distinct consumer preference for high efficiency. The Honda story is the story of one man, Soichiro Honda, and his unparalleled achievement of bringing motor cycles to the masses. He dreamed of a

better way of making piston rings, founded a small company, and began production. He dreamed of giving people everywhere an economical form of transportation, and began producing small motorcycles, including one built in 1949 called the D-Type Dream. He also loved racing too. So his company built bigger and faster machines, two, four, five and six-cylinder race bikes and won the Isle of Man. Honda Motor Company is by far the world's biggest motorcycle maker. Honda was established upon the fundamental belief in the value of each individual. Based on our philosophy, we respect independent spirit and freedom, equality and mutual trust of human beings who work for or come in contact with our company. As such our management policies focus on developing and enhancing the essential characteristics that every individual possesses - capacity to think, reason, and most importantly - the ability to dream. Being the largest producer of 2-wheelers and one of the most admired companies in the world definitely thrills us. But what thrills our associates most is the 'Joy of Creating', one of our missions at Honda, which promotes working for our own happiness. India will be the biggest global market for Honda's two-wheeler business by 2015 before eventually accounting for 30 per cent of its overall market share. At present, this is 13 per cent but the company is going flat out with new product launches as part of an aggressive growth strategy.

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CHAPTER 3

FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN INDIA: AN OVERVIEW

FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN INDIA: AN OVERVIEW

The oil and gas sector in India plays a major role in influencing decision making for all the other important sections of the economy. India's economic growth is closely related to energy demand; therefore the need for oil and gas is projected to grow more, thereby making the sector quite conductive for investment. The Indian Government has adopted several policies to cope up with the increasing demand. The transport residential and industrial sectors are the largest consumers of petroleum products.

3.1 History of the Oil Industry in India

The first oil deposits in India were discovered in 1889 near the town of Digboi in the state of Assam. Oil extracted from the oil wells is in its crude form and contains many impurities. It is refined in oil refineries before use. India's first oil refinery started working way back in 1901 at Digboi in Assam. It remained the only refinery in the world of India for more than half a century. The first well was completed in 1980 and the Assam Oil Company was established in 1899 to oversee production. At its peak during the Second World War, the Digboi oil fields were producing 7,000 barrels per day. However, the British colonial rule laid down much of the country's infrastructure. It was only

in 1954 that another refinery at Tarapur (Mumbai) joined the lone refinery of Digboi. Since then oil refining in India has progressed at a rapid pace.

After India's Independence in 1947, the new government planned to move away the colonial experience and this resulted in a focus on domestic industrial and agricultural production and consumption, a large public sector, economic protectionism and central economic planning. In October 1959, the state owned Oil and Natural Gas Commission (ONGC) was given the powers to plan, organize and implement programmes for the development of oil resources and the sale of petroleum products and also to perform plan sent down from central government. The increased focus on exploration resulted in the discovery of several new oil fields. At the time of economic liberalization when India defaulted on her loans and required its bailout from the IMF, however, the Government still plays a pivotal role and ONGC is still responsible for 77% of oil and 81% of gas production while the India Oil Corporation (IOC) owns most of the refineries putting it within the top 20 oil companies in the world. The Government also maintained subsidized prices. India's choice of energy partners however, most notably Iran led to concerns radiating from the US. A key issue today is the proposed gas pipeline that will run from Turkmenistan to India through politically unstable Afghanistan and Pakistan.

3.2 Reserves:

Although India has a vast areas covered by sedimentary rocks, structures containing oil are not in proportion to the expanses of these rocks and are found in limited situations. The India Mineral Year Book 1982 estimated a reserve of 468 million tonnes of which 328 million tonnes was available in Mumbai High. In 1984 the reserves were estimated at 500 million tonnes. The Indian Petroleum and Natural Gas Statistics put the total reserves of crude oil at 581.43 million tonnes in 1986-87. The prognosticated hydrocarbon resource base in Indian sedimentary basins including deep water has been estimated at about 28 billion tonnes. Of this, only about one-fourth i.e. 72 billion tonnes of in place hydrocarbon reserves have been established as on 1st April 2002. About 70 percent of the established hydrocarbon reserves are oil and rest is gas. The recoverable hydrocarbon reserves are of the order of 2.6 billion tonnes.

3.3 Consumption of Petroleum Products:

The consumption of petroleum products in India excluding private sales and private imports are shown in the table below. It shows the consumption of three types of petroleum products such as Motor Spirit (MS), Superior Kerosene Oil (SKO) and High Speed Diesel (HSD) in India during the year 2010-15.

Table: 3.1 Consumption of Petroleum products in India

Year	MS (in litres)	SKO (in litres)	HSD (in litres)
2010-11	14192	8930	59879
2011-12	14992	8229	64680
2012-13	15744	7501	69034
2013-14	17128	7165	68287
2014-15	19075	7087	69333

Source: Indian Petroleum& Natural Gas Statistics, Govt. of India

Notes: Consumption data excludes private sales and private imports too.

The table above indicates that the consumption of High Speed Diesel (HSD) is the highest in comparison with the other products given in the table. The consumption pattern of these products has increased significantly except for Superior Kerosene Oil (SKO). The reason for the reducing consumption of SKO is due to the economic advancement where Liquefied Petroleum Gas (LPG) has come up to replace SKO for cooking and for other purposes. In the year 2010-11, HSD was consumed the highest next to Motor Spirit (MS) while SKO was consumed the lowest. This had continued till the year 2014-15 where HSD was always the highest consumed product next to MS and then SKO's consumption had started reducing since 2012-13 till date.

The number of fuels consumed in all regions of India has also shown an increasing function. Among the three types of petroleum products mentioned above, HSD and MS are increasing every year while SKO started declining.

CHAPTER 4

TRANSPORT: A GENERAL PROFILE

TRANSPORT: A GENERAL PROFILE

Life becomes simpler and easier and man finds it better to go on vehicles rather than walking on foot. It saves time and energy. These have further led to congestion of roads and an increase in accident rates. The economic development process has brought about this increasing demand for vehicles and this also affect even the farthest part of the world. Development brings about advancement in vehicle type that enters the country.

4.1 Number of Vehicles in Mizoram

Vehicle registration has been taken up by Transport Department, Government of Mizoram. All new vehicles purchased are registered according to their types. The following table indicates the vehicles that were registered in 2009 to 2015:

Table 4.1: Number of Vehicles registered in Mizoram

TYPES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	CAGR(%)
Two-wheeler	42812	50898	60278	70449	80729	90122	16.1
Three-wheeler	2286	2544	3029	3669	4425	4705	16.8
LMV	29624	32475	36126	40021	44318	48373	10.5
HMV	4870	5285	5796	6199	6596	6973	7.4
Others	596	721	876	992	1157	1313	16.8
Total	80188	91923	106105	121330	137225	151486	13.7

Source: Statistical handbook (various issues), Govt. of Mizoram

Fig.4.1 Vehicles registered in Mizoram

Source: Statistical Handbook (various issues), Govt. of Mizoram

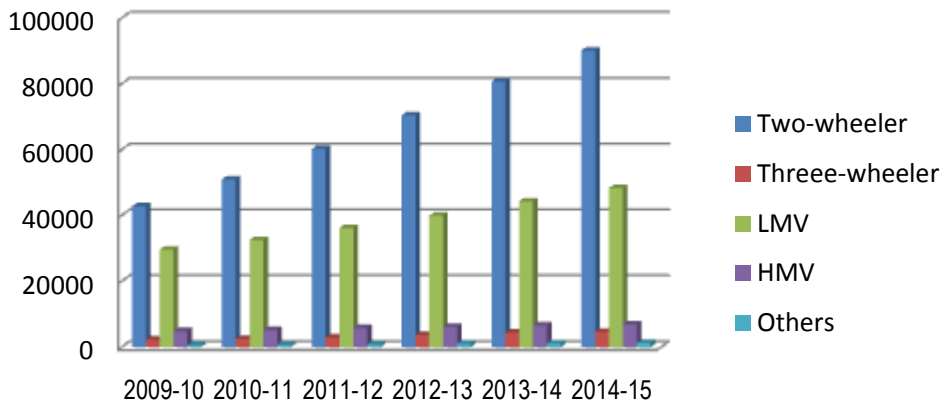

Table 4.1 shows the number of vehicles in Mizoram. The types of vehicles are classified into two-wheelers, three-wheelers, Liquefied Petroleum Gas (LPG)) and others. During the year 2009-15, the number of two-wheelers grew by 47,310, the number of three-wheelers grew by 2,419, Light Motor Vehicle (LMV) grew by 18,749, Heavy Motor Vehicle (HMV) grew by 2,103 and other types of vehicles also grew by 717. The total vehicles registered grew from 80,188 to 151,486 in 2009-10 to 2014-15. There is an increase of 71,298 vehicles during the year 2009-15. The compound annual growth rate of two-wheeler is 16.1%, three-wheeler is 16.8%, LMV is 10.5%, HMV is 7.4% and other type of vehicles is 16.8% respectively. Thus, amongst the vehicles registered, two-wheelers contribute the largest share every year and second are LMV, other types of vehicles contribute the lowest number of vehicles. The total number of each vehicle type also increase every year.

4.2 Growth of Vehicles in Mizoram

The vehicle population has been increasing in every districts of Mizoram as shown in the table below. Every 8 districts show an increasing vehicle population each year. The table includes all vehicle types, government vehicles and private vehicles.

Table 4.2: District-wise Growth of Vehicles in Mizoram

Year	AIZAWL	LUNGLEI	SAIHA	CHAMPHAI	KOLASIB	SERCHHIP	MAMIT	LAWNGTLAI
2009-10	61131	6782	1845	3190	4223	1933	497	587
2010-11	68846	8032	2073	3757	4943	2447	837	987
2011-12	77835	9439	2532	4638	5865	3090	1316	1452
2012-13	87441	10941	3050	5729	6751	3721	1761	1936
2013-14	97763	12401	3493	6897	7750	4476	2101	2344
2014-15	107458	13611	3927	7685	8608	5014	2416	2767
Total	500474	61206	16920	31896	38140	20681	8928	10073

Source: Transport Department, Govt. of Mizoram

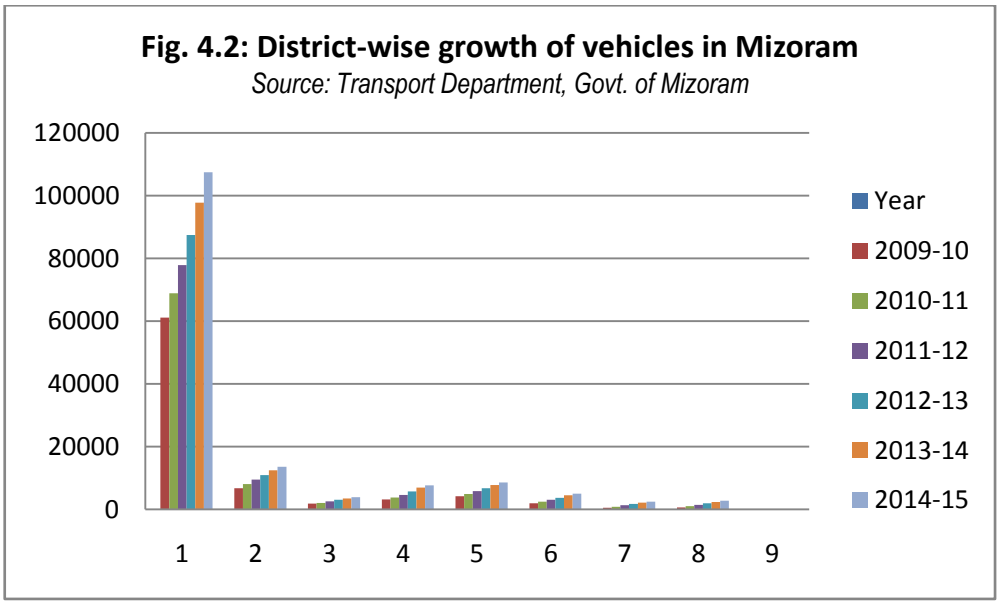

Table 4.2 indicates district-wise growth of vehicles in Mizoram (both Government and non-Government). In 2009-10 to 2014-15, the vehicle population in Aizawl grew from 61,131 to 107,458 and in

Lunglei district vehicles grew from 6,782 to 13,611 while in Mamit district vehicles grew from 497 to 2,416 only. As given in the table, the total number of vehicles registered in Aizawl district is 500,474 and Mamit district is only 8928. Therefore, out of the eight districts, the growth of vehicles is highest in Aizawl every year while the lowest vehicle population is found to be located at Mamit. Lunglei district also contribute a large share in the number of vehicle population next to Aizawl. The other districts viz, Saiha, Champhai, Kolasib, Serchhip and Lawngtlai also continue increasing every year.

4.3 FUELS AND ITS DISTRIBUTION IN MIZORAM

The need for fuels has been highly increasing during the last ten decades. This occur in every part of India, motor industries have also grown up at a very fast pace to meet the requirements of the developing country and its increasing population. Different types of vehicles came up with smarter and better technologies and there are vehicles with Diesel engine and Petrol engine. These increasing vehicles demand for more fuels, the consumption of Diesel and Petrol also increases every year. Majority of the people still demand for domestic-used fuels for cooking and for other purposes. Many people rely on SKO and therefore Government also supplies this fuel at a subsidized rate.

4.3.1 Fuel Consumption in Mizoram

The consumption of fuels in Mizoram is different from each other, among the three fuels given in the table, MS and Diesel are used in vehicles and kerosene is mostly used in households. The consumption of fuel type differs according to the vehicle type available in Mizoram. The following table indicates the consumption of such fuels in different years.

Table 4.3 : Fuel Consumption in Mizoram during the year 2010-15

	Quantity(in kilo litres)				Percentage			
Year	MS	HSD	SKO*	Total	MS	HSD	SKO	Total
2010-11	21,744	47,150	7476	76,370	28.48	61.73	9.79	100
2011-12	24,462	55,200	7476	87,138	28.07	63.34	8.58	100
2012-13	25,821	60,950	7476	94,247	27.40	64.68	7.93	100
2013-14	29,898	60,950	7476	98,324	30.40	61.99	7.60	100
2014-15	31,257	62,100	7476	100,833	30.99	61.59	7.41	100

*average consumption is given due to insufficient data

Source: Indian Petroleum and Natural Gas Statistics, 2014-15, Govt. of India

Table 4.3 shows the consumption of Motor Spirit (MS), High Speed Diesel (HSD) and Superior Kerosene Oil (SKO) in Mizoram during the year 2010-15. The consumption of MS increased from 21,744 KL to 31,257 KL during the year 2010-11 to 2014-15 and Diesel increased from 47,150 KL to 62,100 KL in 2010-11 to 2014-15, the consumption of Kerosene remains 7476 KL till 2014-15. The consumption percentage of MS grew from 28.48% to 30.99% in 2010-11 to 2014-15, Diesel was 61.73% in 2010-11 and it has increased to

63.34% in 2011-12 and again rose to 64.68% in 2012-14 but in the next year it has declined to only 61.99% in 2013-14 and remained 61.59% in 2014-15. SKO remain constant at 20%. Amongst the three fuel types, the consumption of Diesel is highest in Mizoram and next is Motor Spirit.

4.3.2 Fuel Pumps in Mizoram

The number of Filling Stations in each district is also different and such stations include Government owned and private owned fuel stations. The details are given in the table below:

Table 4.4: Number of Filling Stations in Mizoram

Year	Number of Petrol Pumps
2006-07	15
2007-08	18
2008-09	23
2009-10	25
2010-11	25
2011-12	27
2012-13	26
2013-14	27

Source: Statistical abstract of Mizoram, 2013

Table 4.4 indicates the number of filling stations in Mizoram during the year 2006-14. There were filling stations in 2006-07, an increase in vehicles and development process brings about more

demand for fuels, therefore, in the year 2013-14, the number of petrol pumps has increased to 27.

4.3.3 Selling Pattern of Fuels in Fuel Stations

An increase in the number of vehicles creates more demand for fuels and this further generate the establishment of fuel stations in different locations. These growing fuel stations in different areas of Mizoram are mostly privately owned stations, while Mizofed is a semi- Government. The selling of fuels in each station is different as is shown in the table below:

Table 4.5. : Selling of fuels in Aizawl City during the year 2014-15

Fuel Pumps	MS (kilo litres)	Percentage	HSD(kilo litre)	Percentage
Mizofed	2052	11.73	1076	2.38
Zangena & Bros	2120	12.12	2016	4.46
Lalsangliana	420	2.40	1212	2.68
Hrangbana	736	4.20	2876	6.36
Hauva	836	4.78	1352	2.99
K.Lalnghakliana	1656	9.47	2112	4.67
Biakliana	2576	14.73	1480	3.27
Lalboi	1248	7.13	1392	3.08
Lalthanzauva	672	3.84	23436	51.88
Aizawl Bypass	492	2.81	856	1.89
Lalruatkima	1076	6.15	1840	4.07
Singson*	2160	12.35	3000	6.64
Zemabawk*	1440	8.23	2520	5.57
Total	17484	100	45168	100

*average sales is given due to insufficient data

Source: Indian Oil Corporation Ltd (IOC), Vairengte DEPOT, Mizoram

Table 4.5 shows the selling pattern of fuels in Aizawl City. At present, there are 13 fuel stations and these fuel stations sell Motor Spirit (MS), Extra Premium (XP) and High Speed Diesel (HSD) in their stations. Out of these stations, Mizofed is a semi-Government and other pumps are privately owned by individuals. The sale of HSD is higher than the sale of MS, but this does not mean that the number of vehicles consuming HSD is more in Aizawl, what this finding actually presented is that the vehicles consuming HSD are mainly commercial vehicles whose fuel consumptions is much higher that the vehicles consuming MS. As in seen in the table above, the best seller Biakliana Filling Station sold out 2576KL of MS during the year 2014-15, Singson sold out 2160KL of MS next to Biakliana and Lalsangliana sold out 420KL during the year. In the case of HSD, the best seller of Diesel type of fuel is Lalthanzauva Filling Station with 23436KL during the year 2014-15, next best seller is Singson with 3000KL and Aizawl Bypass is recorded to be the lowest seller with only 856KL of Diesel during the year. The total sale of MS type of fuel during the year 2014-15 is 17484KL and the total sale of HSD is 45168KL.

CHAPTER 5

PROFILES OF TWO-WHEELER RIDERS IN AIZAWL CITY: AN EMPIRICAL ANALYSIS

PROFILES OF TWO-WHEELER RIDERS IN AIZAWL CITY: AN EMPIRICAL ANALYSIS

Two-wheelers occupy the largest number among the existing vehicles in Mizoram. The same case happens in Aizawl City. Nowadays, not only male riders but also female riders are available to be seen with the introduction of new brands of two-wheelers that suits females to ride on. For the Aizawl city, two-wheelers are convenient in traffic jams and so on. Two-wheeler riders and their profiles are indicated in the following figures with their consumption patterns of petrol, their running condition etc.

5.1 Age-Sex Profiles

This profile of riders have shown an involvement of males and females among different age groups of two-wheeler owners.

Table 5.1: Age-Sex Profiles of Two Wheeler Riders in Aizawl City

Age Group	No. of Persons			Percentage		
	Male	Female	Total	Male	Female	Total
20-29	21	14	35	42	70	50.0
30-39	18	5	23	36	25	32.9
40 & above	11	1	12	22	5	17.1
Total	50	20	70	100	100	100

Source: Sample Survey, March 2016

Fig.5.1 : Age-sex Profiles of Two-wheeler Riders

Source: Sample Survey, March 2016

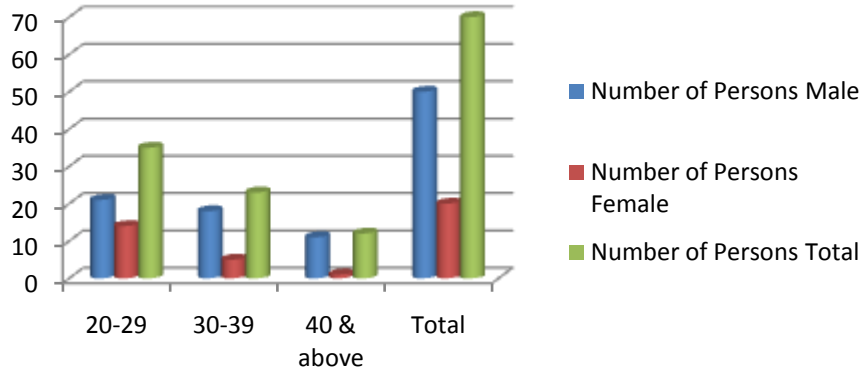

Table 5.1 shows the age-sex profiles of two-wheeler riders in Aizawl City. Out of the 70 respondents, 50 riders are males while 20 riders are females. Thus, majority of the respondents are male riders. The age group 20-29 consists of 35 two-wheeler riders with 50%, the age group 30-39 consists of 23 riders with 32.9% and only 12 riders are in the age group 40 years and above which is only 17.1%. Therefore, most of the two-wheeler riders are in the age group 20-29 and only few riders are concentrated in the age group 40 years and above.

5.2 Factors of Ownership

Table 5.2: Major Factors determining Ownership of Two Wheelers in Aizawl City

Factors	No. of Riders			Percentage		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Income Groups (Rs)						
below 10000	12	8	20	24	40	28.57
10000-30000	28	12	40	56	60	57.14
30000-60000	7	0	7	14	0	10.00
60000&above	3	0	3	6	0	4.29
Total	50	20	70	100	100	100
Employment Status						
Employed	43	13	56	86	65	80
Not-employed	7	7	14	14	35	20
Total	50	20	70	100	100	100

Source: Sample Survey, March 2016

Table 5.2 shows the factors that determine the ownership of two-wheelers in Aizawl City. In the table, the income pattern of two-wheeler owners and their employment status are exposed. There are 20 riders i.e. 28.57% whose monthly income is below Rs10000 and there are 40 riders i.e. 57,14% with monthly income of Rs 10000-30000, 7 riders i.e. 10% of the respondents have a monthly income of Rs 30000-60000 and only 3 riders i.e. 4.29% are in the monthly income group of Rs 60000 and above. Hence, majority of the riders have an income of Rs 10000-30000 and the least number of riders have an income of Rs 60000 and above. In general, household income is the key determinant of the number and the sizes of vehicles that households own. It reveals that household size is a large significant factor; even though smaller vehicles are also preferred by larger households, lower income groups mostly prefer smaller vehicles. Some of the possible reasons for these

preferences are the relative expense of larger vehicles, tax enforcement etc.

5.3 Two-wheeler Types and Selection

Table 5.3: Ownership of Two Wheeler Types and Reasons for its Selection

Cases	No. of Riders			Percentage		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Type of Two Wheelers						
Bike	40	1	41	80	5	58.6
Scooty	10	19	29	20	95	41.4
Total	50	20	70	100	100	100
Whether the Owner Could Ride Before						
Could Ride	41	13	54	82	65	77.1
Could Not Ride	9	7	16	18	35	22.9
Total	50	20	70	100	100	100
Reason for Selection of Two Wheeler Types						
Model	24	17	41	48	85	58.6
Fuel Efficient	12	2	14	24	10	20
Price	8	0	8	16	0	11.4
Others	6	1	7	12	5	10
Total	50	20	70	100	100	100

Source: Sample Survey, March 2016

Table 5.3 shows the type of two-wheelers owned by riders and the reasons for the selection of different type of two-wheelers. There are 40 male riders and one female rider who own a bike, 10 male riders own a scooty while 19 female riders own a scooty. Consequently, among the respondents, 41 riders i.e. 58.6% own bikes and 29 riders i.e. 41.4% own scooty. Then, male riders mostly own bikes while female riders mostly own scooty. As shown in the table, 41 male riders and 13 female riders know how to ride before owning their vehicle, while 9 male riders

and 7 female riders do not know how to ride before owning their vehicles, thus, 77.1% knows how to ride while 22.9% do not know how to ride before purchasing their two-wheelers. As a result, there are more male riders than female riders who could ride two-wheelers while purchasing. There are also different reasons for selecting the type of two-wheelers among the riders when purchasing. Out of the 70 respondents, 41 riders i.e. 58.6% prefer the model in selecting the type of two-wheeler, 14 riders i.e. 20% prefer fuel efficient one, 8 riders i.e. 11.4% care for the price and 7 riders i.e. 10% select the type of two-wheeler for other purposes. Therefore, majority of the riders prefer the model when selecting two-wheelers and the least number of riders select for different purposes.

5.4 Pattern of Fuel Consumption

Table 5.4: Pattern of Fuel Consumption among the Two Wheeler Riders in Aizawl - CC Wise

Cubic Centimetre (CC)	Petrol Consumption Per Week (Litre)		Weekly Expenditure on Petrol (Rs)		Distance Covered Per Week (km)	
	Average	SD	Average	SD	Average	SD
below 150	4.39	1.60	321.48	116.08	8.70	6.70
150-250	3.84	2.28	497.11	777.29	10.72	8.80
250&above	3.80	1.30	203.00	68.34	6.60	2.30
Total	4.05	1.98	408.36	582.82	9.65	7.77

Source: Sample Survey, March 2016

Table 5.4 shows the pattern of fuel consumption among the two-wheeler riders in Aizawl City. The Cubic Centimetres (CC) of two-

wheelers are classified into three i.e. below 150CC, 150-250CC and 250CC & above respectively. In the above table, the average weekly petrol consumption of the CC range below 150 is 4.39 litres, the CC range 150-250 is 3.84 litres and the CC range above 250 is 3.80 litres. Their corresponding Standard Deviations of the CC range are 1.60, 2.28 and 1.30 respectively. Thus, this empirical study indicates that each two wheeler with CC below 150 consumed 4.39 litres of petrol per week which is verified by the corresponding low Standard deviation. This means that the average taken is reliable enough to represent this range, indicating consistency and homogeneity. Similarly, the average weekly petrol consumption of two wheelers with CC range 150-250 is 3.84 litres. This is also verified by its corresponding low value of standard deviation. Again, the average weekly petrol consumption of CC range 250 and above is 3.80 litres, and its standard deviation is 1.30. Then, CC below 150 consumes the highest amount of petrol in comparison with the other CC and the total average petrol consumption of every CC per week is 4.05 litres and their total Standard Deviation is 1.98.

In terms of average weekly expenditure on petrol, below 150CC range is Rs 321.48, 150-250CC is Rs 497.11 and above 250CC range is Rs 203 respectively. Their corresponding Standard Deviation is 116.08, 777.29 and 68.34 respectively. Thus, their total average weekly expenditure on petrol is Rs 408.36 and their total Standard Deviation is 582.82.

The average distances covered by the riders below CC range 150 is 8.70 km, 150-250CC is 10.72 km and above 250CC range is 6.60 km respectively. Their corresponding Standard Deviation is 6.70, 8.80 and 2.30 respectively. Therefore, their total average weekly distances covered by the riders is 9.65 km and their total Standard Deviation is 7.7.

Table 5.5: Usage and Pattern of Fuel Consumption among the Two Wheeler Riders

Particulars	**Bike**		**Scooty**		Total	
	Mean	SD	Mean	SD	Mean	SD
Petrol Consumption Per Week (Litre)	3.78	2.19	4.43	1.59	4.05	1.98
Expenditure on Petrol Per Week (Rs)	465.98	753.45	326.90	119.79	408.36	582.82
Distance Covered Per Week (Km)	10.50	8.47	8.45	6.61	9.65	7.77

Source: Sample Survey, March 2016

Table 5.5 shows the usage and patterns of fuel consumption among the two-wheeler riders in Aizawl city. Amongst the bike riders, their average petrol consumption per week is 3.78 litres, and for scooty, it is 1.59 litres. The average expenditure on petrol per week for bike riders is Rs 465.98 and for scooty riders it is Rs 326.90. The average distance covered by bike riders is 10.50 km and for scooty riders it is 8.45 km. Then, the total average weekly petrol consumption for both bikes and scooty is 4.05 litres, the average weekly expenditure on petrol for both bikes and scooty is Rs 408.36 and their average weekly distance covered is 9.65.

The total standard deviation of weekly petrol consumption for both bikes and scooty is 1.98, their total standard deviation of the weekly expenditure on petrol is 582.82 and their total standard deviation of the weekly distance covered is 7.77.

5.5 Distance Covered by Two-wheeler Riders

Table 5.6: Distance Covered Per Week by Two Wheeler Riders in Aizawl City

Status	Measure	Distance covered per week (km)	Expenditure on Petrol Per Week (Rs)
Employment Status			
Employed	Mean	9.7	436.5
	Std. Deviation	7.3	646.7
Unemployed	Mean	9.5	295.7
	Std. Deviation	9.8	128.5
Combined	Mean	9.7	408.4
	Std. Deviation	7.8	582.8
Sex of the Riders			
Male	Mean	10.2	439.1
	Std. Deviation	8.2	684.4
Female	Mean	8.2	331.5
	Std. Deviation	6.4	129.9
Combined	Mean	9.7	408.4
	Std. Deviation	7.8	582.8
Age Groups of the Riders			
20-29	Mean	10.4	307.0
	Std. Deviation	8.3	141.8
30-39	Mean	9.9	642.6
	Std. Deviation	8.2	969.0
40 & above	Mean	7.1	255.0
	Std. Deviation	5.1	132.8
All Groups	Mean	9.7	408.4
	Std. Deviation	7.8	582.8

Source: Sample Survey, March 2016

In table 5.6, the weekly average expenditure on petrol for employed riders is Rs 436.5 and Rs 295.7 for unemployed riders. The average distance covered for employed riders is 9.7 km and 9.5 km for unemployed riders respectively. This indicates that employed riders run more distances and spent more money on petrol consumption than the unemployed riders.

The table shows that male rider's average weekly distance covered is 10.2 km and for females it is 8.2 km. Then, the average weekly expenditure on petrol for males is Rs 439.1 and for females it is Rs 331.5 respectively. Thus, this shows that male riders run more distances than females in a week and their expenditure on petrol is also more than female riders.

The age groups of the riders are also given in the table. The average weekly distance covered by the age group 20-29 is 10.4 km, for age group 30-39 it is 9.9 km and for the age group above 40 years it is 7.1 km respectively. Then, the average weekly expenditure on petrol by the age group 20-29 is Rs 307, for the age group 30-39 it is Rs 642.6 and for the age group 40 years and above it is Rs 255. Therefore, this indicates that the riders in the age group 20-29 cover more distances weekly than the other age groups and that the average weekly expenditure on petrol is highest amongst the age group 30-39.

CHAPTER 6

MAJOR FINDINGS AND CONCLUSION

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Findings

1. In the field survey, there are 40 male riders and one female rider who owns a bike, 10 male riders and 19 female riders own scooty. Male riders mostly own bikes while female riders mostly own scooty. Besides these, there are also 41 male riders and 13 female riders who know how to ride before owning their vehicle. As such, male riders mostly knew how to ride before owning their vehicle. The study also reveals that while selecting a vehicle for purchase, the consumers choose vehicles based on their model and followed by the price and fuel efficiency. *(Objective No.1)*

2. Majority of the riders has an income of Rs 10000-30000 and the least number of riders have an income of Rs 60000 and above. In general, household income is the key determinant of the number and the sizes of vehicles that households own. It reveals that household size is a a significant factor; even though smaller vehicles are also preferred by larger households, lower income groups mostly prefer smaller vehicles. Some of the possible reasons for these preferences are the relative expense of larger vehicles, tax enforcement etc. (*Objective No. 2*)

3. The study reveals that amongst the bike riders, their average petrol consumption per week is 3.78 litres and for scooty, it is 1.59 litres. The average expenditure on petrol per week for bike riders is Rs

465.98 and for scooty riders it is Rs 326.90. The average distance covered by bike riders is 10.50 km and for scooty riders it is 8.45 km. Then, the total average weekly petrol consumption for both bikes and scooty is 4.05 litres, the average weekly expenditure on petrol for both bikes and scooty is Rs 408.36 and their average weekly distance covered is 9.65kms. (*Objective No.2*)

4. At present, there are 13 fuel stations and these fuel stations sell Motor Spirit (MS), Extra Premium (XP) and High Speed Diesel (HSD) in their stations. Out of these stations, Mizofed is a semi-Government and other pumps are privately owned by individuals. The sale of HSD is higher than the sale of MS, but this does not mean that the number of vehicles consuming HSD is more in Aizawl, what this finding actually presented is that the vehicles consuming HSD are mainly commercial vehicles whose fuel consumptions is much higher that the vehicles consuming MS.(*Objectives No.3*)

5. Biakliana Filling Station was the best seller who sold out 2576KL MS type of fuel during the year 2014-15. In the case of HSD, the best seller of Diesel type of fuel was Lalthanzauva Filling Station with 23436KL during the year 2014-15. The total sale of MS type of fuel during the year 2014-15 is 17484KL and the total sale of HSD is 45168KL. (*Objective No. 3*)

6. Average weekly expenditure on petrol, below 150CC range is Rs 321.48, 150-250CC is Rs 497.11 and above 250CC range is Rs 203 respectively. In this case, 150-250 CC spends the highest amount of money for petrol. Then again, CC range 150-250CC covered the longest average distance of 10.72 km than the other CC. (*Research questions no.1)*

7. The weekly average expenditure on petrol for employed riders is Rs 436.5 and Rs 295.7 for unemployed riders. The average distance covered for employed riders is 9.7 km and 9.5 km for unemployed riders respectively. This indicates that employed riders run more distances and spent more money on petrol consumption than the unemployed riders. (*Research questions No.2*)

8. Among the vehicles registered in Aizawl city, two-wheelers contributes the largest share every year and the second contributors are LMV.

9. Out of the eight districts, the growth of vehicles is highest in Aizawl every year while the lowest vehicle population is found to be located at Mamit. Lunglei district also contribute a large share in the number of vehicle population next to Aizawl. The other districts viz, Saiha, Champhai, Kolasib, Serchhip and Lawngtlai also continue increasing every year.

10. The consumption of MS increased from 21,744 KL to 31,257 KL during the year 2010-11 to 2014-15 and Diesel increased from 47,150 KL to 62,100 KL in 2010-11 to 2014-15, the consumption of Kerosene remains 7476 KL till 2014-15. Amongst the three fuel types, the consumption of Diesel is highest in Mizoram and next is Motor Spirit.

11. In Mizoram, there were 15 petrol pumps in 2006-07, an increase in vehicles and developmental processes brings about more demand for fuels. In the year 2013-14, the number of petrol pumps has increased to 27.

12. Most of the two-wheeler riders are in the age group 20-29 and only few riders are concentrated in the age group 40 years and above.

13. In the field survey, the Cubic Centimetres (CC) of two-wheelers are classified into three i.e. below 150CC, 150-250CC and 250CC & above respectively. The average weekly petrol consumption of the CC range below 150 is 4.39 litres, the CC range 150-250 is 3.84 litres and the CC range above 250 is 3.80 litres. Thus, CC below 150 consumes the highest amount of petrol in comparison with the other CC and the total average petrol consumption of every CC per week is 4.05 litres.

14. The study also found out that male rider’s average weekly distance covered is 10.2 km and for females it is 8.2 km. Then, the average weekly expenditure on petrol for males is Rs 439.1 and for females it is Rs 331.5 respectively. Thus, this shows that male riders run

more distances than females in a week and their expenditure on petrol is also more than female riders.

15. The average weekly distance covered by the age group 20-29 is 10.4 km, for age group 30-39 it is 9.9 km and for the age group above 40 years it is 7.1 km respectively. Then, the average weekly expenditure on petrol by the age group 20-29 is Rs 307, for the age group 30-39 it is Rs 642.6 and for the age group 40 years and above it is Rs 255. Therefore, this indicates that the riders in the age group 20-29 cover more distances weekly than the other age groups and that the average weekly expenditure on petrol is highest amongst the age group 30-39.

Conclusion

This whole study thus involves the consumption pattern of different types of fuels in Mizoram and also shows the increasing pattern of two-wheelers and other type of vehicles in Mizoram. It also includes the consumption pattern of petroleum products in India. The study focused only the Aizawl city since it is the most populated area and also the capital of the state of Mizoram. The world is encouraged by the expanding number of vehicles for simplicity and this further craves for more fuels to satisfy the needs of vehicles. This increasing vehicle is followed by an increasing consumption of fuels in every city. As such, this requires the need to study the consumption pattern of fuels of vehicle owners. Amongst the vehicles available in Mizoram, two-wheelers are the most commonly bought vehicles by consumers. Thus, the study is confined to two-wheelers only. The major findings of the study also include the import of fuels of different filling stations, the rider's consumption pattern of fuels and their vehicle type of selection.

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APPENDIX: STRUCTURED QUESTIONNAIRE

PATTERN OF FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN AIZAWL CITY

General Information of the Respondents:

1. Sex: ( ) Male ( ) Female

2. Educational Qualification: _____

3. Age: (i) 20-29 (ii) 30-39 (iii) 40 above.

4. House: ( ) Owned ( ) Rented

5. Are you employed? ( ) Yes ( ) No

   If yes: _____

6. Monthly Income: (i) Below Rs10000 (ii) Rs 10000-30000

   (iii) Rs 30000-60000 (iv) Rs 60000 above

7. Family main occupation: (i) Govt. Servant (ii) Business

   (iii) Private Company (iv) Others

8. In which year did you purchase your two-wheeler? _____

9. Type: ( ) Bike ( ) Scooty

10. Cubic Centimetre (CC): _____

12. Brand: ( ) New ( ) Secondhand

13. Price: _____

14. Average kilometer you run every day. _____

15. Average litres of petrol consumed per weekly. _____

How much money have you spent on it? _____

16. How frequent have you changed your engine oil? _____

How much money have you spent on it? _____

17. The frequency of your engine-oil change. _____

18. How many years have you run your two-wheeler? _____

19. Are you satisfied with the performance so far? _____

20. Are you a learned rider while purchasing your vehicle? _____

21. Give reason for selecting your two-wheeler while purchasing.

(i) its model (ii) fuel economy

(iii) its price (iv) other reason

22. Does the age of your vehicle affect the fuel efficiency in your opinion?

( ) Yes ( ) No

23. Do you have a garage? ( ) Yes ( ) No

24. Are you a devoted member of your Church and in your society?

( ) Yes ( ) No

25. Do you think your participation affect your petrol consumption?

( ) Yes ( ) No

AN

M.PHIL ABSTRACT

ON

PATTERN OF FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN AIZAWL CITY

BY

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INTRODUCTION

This study analyses household economic behaviour with regards to fuel consumption deviates from the well beaten path of primitive economy. Households having the capability of consuming fuel oil naturally belong to the middle class or elite group of the society. In temporal sense, the spurt of oil consumption is comparatively recent phenomenon in Mizoram though the first car oil-refinery was set up in USA in 1850. Furthermore, the use of motorized vehicle is possible only when there is a good network of roads. In view of this, the study is confined to cross-sectional data within the Aizawl city.

Fuels are any materials that store potential energy in forms that can be practicably released and used for work or as heat energy. The name petroleum covers both naturally occurring unprocessed crude oil and petroleum products that are made up of refined crude oil. Diesel fuel is any liquid fuel used in diesel engines, whose fuel ignition takes place, without spark, as a result of compression of the inlet air mixture and then injection of fuel Fuels are those materials storing energy in the form of chemical energy that could be released through combustion. As a result of the growth of the economy, the demand for fuel is increasing; fuel demand growth is primarily driven by the growth in the vehicle population, especially private vehicle passengers. The fuel economy of two wheelers is the fuel efficiency relationship between the distance travelled and the amount of fuel consumed by it. Consumption of fuel can be expressed by the volume of fuel to travel a distance or the distance travelled per unit volume of fuel consumed. Fuel consumption is a more accurate measure of vehicle performance.

Two wheeler industries have been in the country since 1955. It consists of three segments Mopeds, motorcycles and scooters/ gearless scooters. Two-wheeler plays an important role in the growth of the Indian automobile industry. The demands for two wheelers have witnessed a sea change over the years. With the rising income levels and standard of living, there is a rapid rise in the demand for two wheelers in the country. Some of the two wheeler manufacturers in India are- Hero Honda Motors Ltd, Bajaj Auto, TVS Motor Company, Majestic Auto Ltd, Kinetic, Suzuki Bikes and Scooters.

Two wheelers in Mizoram use only petrol fuel. It is well known that during the last three decades, there has been a rapid increase in vehicle population in Mizoram. This study analyses fuel consumption by households and whether they value fuel efficient vehicle or not. This study is necessary since the vehicle owners in Aizawl city may not keep in mind the fuel efficiency while purchasing their vehicles, they may care only for the model, its engine size and the price only. The less efficient vehicles may be less expensive while purchasing but when considering its fuel consumption, the less efficient vehicles may be highly expensive later on. Therefore, it is necessary to care for vehicles that reduces fuel and emissions.. Aizawl is encouraged by the expanding number of two wheelers. The demand for more fuels has created insufficiency of fuels in the study. An empty fuel in fuel pumps even just for a day has become a huge problem these days. The deteriorating quality of public transport may also drive the people to personalized transport. Rise in disposable income affect the purchasing level of two wheelers and other vehicles.

OBJECTIVES OF THE STUDY

i) To study the factors that influences the selection of vehicle by customers.

ii) To examine the pattern of fuel consumption among the two wheeler owners.

iii) To identify the different types of fuels consumed by the two-wheeler owners and also to analyze the pattern of sells by the filling stations.

RESEARCH QUESTIONS

1. Which among the two wheeler vehicles consume more fuel depending on their cubic centimetres?

2. Is there any difference in the expenditure on fuel consumption among the employed and unemployed riders?

METHODOLOGY

The study is carried out with the help of Primary and Secondary data. Primary data is collected through field survey and by studying questionnaires to prospective respondents, the attitude of motorized two-wheeler owners towards their vehicles and their socio-economic life. Secondary data is collected through an official document of Mizoram State Transport Department and Directorate of Food, Civil Supplies and Consumer Affairs, Government of Mizoram and also from websites. The survey was conducted through structured questionnaires by taking sample size of 70 two-wheeler riders in Aizawl city. There are only 10 fuel stations in Aizawl as recorded by Indian Oil Corporation Limited (IOC), Vairengte,

besides these there are three other stations who import their oils from the Hindustan Petroleum Corporation Limited (HPCL) and Bharat Petroleum Corporation Limited (BPCL), therefore necessary information is also taken from these three fuel stations also. Appropriate quantitative technique is also applied as an analytical tool wherever appropriate.

AREA OF THE STUDY

Aizawl is the capital of the state of Mizoram in India. It is the largest city in the state. It is also the centre of administration containing all the important government offices, state assembly house and civil secretariat. The economy of Aizawl is basically sustained by government services. As of 2011 India census, Aizawl had a population of 293,416. Females constitute 144,913 i.e. 50.61% of the population and males are made up the remaining 148,503 i.e. 49.39%.

STATEMENT OF THE PROBLEM

Development has brought about an increase in vehicles even in Mizoram and other parts of the world. Shortage of fuel in fuel stations just for a day has become a huge problem. Aizawl is encouraged by the expanding number of two wheelers and how this affects the consumption of fuel in Aizawl among the owners of the motorized two-wheelers. There is no specific study about the consumption patterns and the supply of fuels in the City to meet its requirements. Therefore, the study about the

consumption of this necessity is required to find out how far the Aizawl city has its dependence on fuels in everyday life.

REVIEW OF LITERATURE

Haworth N et.al (2001), in their report examines the possible safety benefits from driving in a manner that result in lower fuel consumption and emissions. Both road safety and the environment are critically affected by the extent of the use of motor vehicles and the specific ways in which they are driven. It attempts to assess the potential of promoting additional motivations to drive safely-better fuel economy and other environmental outcomes, and reduced running costs. From an environmental perspective, fuel consumption results in the production of vehicle emissions which can be classified into air pollutants (which affect health) and greenhouse gas (which affect the environment). Smoother driving has great potential for reducing fuel consumption and emissions in urban areas than in open road travel. At the level of individual vehicle, smoother driving can lead to greater reductions in fuel consumption than lower travel speeds in urban areas. The resulting reduction in emissions of air pollutants is expected to be greater than the reduction in greenhouse gas emissions. The environmental benefits of smoother driving may be greater than the road safety benefits but this is yet to be established. More information is needed about the road safety effects of smoother driving. The possible effect on following distance of drivers attempting to maintain a steady speed has not been investigated. The nature of instructions to be given to drivers, particularly of automatic vehicles, needs further study. Further work on the interaction between driving style, speed limit and street length should be

undertaken to establish whether different instructions should be given according to these variables. Reducing speeding, lower speed limits and modifying driving style were found to improve fuel economy and other environmental outcomes in addition to improving safety. Community attitude surveys suggest that there will be greater support for measures that aim to improve fuel economy than for those that attempt to reduce vehicle travel. In addition, reducing fuel consumption rate without requiring a change in vehicle choice may be more acceptable and more easily implemented in the short-term.

Padam S et.al, (2004), in their paper attempts to highlight the need for a cogent urban transport policy without which there will be ad hoc interventions. Such interventions, apart from not adding up to a comprehensive approach, will result in greater confusion. Furthermore, it emphasizes that if there is no worthwhile public transport, it will still need to be reinvented to promote a better quality of life. Cities play a vital role in generating economic growth and prosperity. The sustainable development of cities largely depends upon their physical, social and institutional infrastructure. In this context, the importance of transport infrastructure is paramount. To facilitate this, what is required is a sound urban transport policy. The number and size of cities have also increased considerably. Although circumstances differ considerably across cities in India, certain basic trends which determine transport demand (such as substantial increase in urban population, household incomes, and industrial and commercial activities) are the same. These changes have placed heavy demands on urban transport systems, a demand that many Indian cities have been unable to meet. Among various factors affecting the quality of life and safety in a city, the transport system is among the most important. It has a direct correlation with air quality and safety. The urban transport situation

in large cities in India is deteriorating. The deterioration is faster in metropolitan cities where there is an excessive concentration of vehicles. Mass transport is scarce, overcrowded, unreliable, and involves long walking periods. Considering the population growth in most Indian cities, the urban transport infrastructure thus needs to be increased manifold over the next few years, if the gap in the demand and supply has to be eliminated. The development of roads and infrastructural facilities has not kept pace with the growth of motor vehicles. The transport crisis faced by most of the metropolitan cities in India harms business efficiency, threatens to undermine the city's competitive position, and worsen the people's quality of life. Without vigorous action, all of these problems would intensify, as rising population over the coming decades and the goal of growing economic prosperity put more pressure on the system. Achieving this requires not only overcoming chronic under-investment, but also a complete overhaul of public transport management. Urban areas, whether mega-cities, cities or towns, have grown and are growing. The demands they are making have remained largely unmet. The deteriorating quality of public transport is driving people to personalized transport, most of which are fuel-inefficient, congesting and unsafe.

Agarwal O.P (2006), in his paper discusses that the increased travel demand has resulted in rapid growth in the number of motor vehicles in the cities. In the six major metropolises of India, growth in motor vehicles has outpaced population growth. On an average, while the population in India's six major metropolises increased 1.89 times during 1981 to 2001, the number of registered vehicles went up 7.75 times during the same period. Thus the growth of motor vehicles was almost four times faster than the growth of population. This growth has been largely driven by the growth in the number of two-wheelers. The largest share of the vehicular fleet in the six metropolises also comprises of two-wheelers. Cities with better public

transport systems, especially those with rail based mass transit systems—Kolkata and Mumbai—show a relatively lower share of two-wheelers and total registered vehicles. The large cities have faced major problems, which the smaller ones have, so far, not been noticeably affected by. Most prominent among them is the high level of air pollution caused by motor vehicles. Pavement dwellers, road side hawkers, cyclists and pedestrians are most dangerously exposed to motor vehicle exhaust. The emerging pattern of urban mobility has also had its impact on the consumption of petroleum products, which has gone up substantially. The net foreign exchange outflow on importing crude oil and petroleum products increased from about Rs 5250 crore in 1980–1 to Rs 112,000 crore in 2004–05 (GOI 2005). The rising trend in the consumption of petroleum products has a bearing on India's energy security, especially because India depends on imports for a large share of its crude oil requirements. A strategy to reduce personal motor vehicle use is to promote the use of non-motorized modes as they are 'greener' modes of travel. Vehicles travelling at a steady speed emit fewer pollutants than a vehicle requiring frequent starts and stops or spending considerable time in idling. Hence the focus of traffic flow improvements is to enable a vehicle to move at a steady speed and reduce the incidence of starts and stops. Several measures are necessary to bring about the required improvements in public transport. To begin with a public transport system design, which can be developed within city constraints given the city's topography, time taken to develop the systems and improve accessibility to people would be an ideal system. Urban public transport in India is underdeveloped resulting in congestion on roads due to mixed traffic. Unreliable and rudimentary public transport systems have led to increased dependence on small, motorized vehicles among urban population. Urban transport in most cities suffers from lack of planning as well as amorphous nature of responsibilities assigned to various central,

state and local government agencies. Demand for urban transport is expected to double by 2030, hence, there is an urgent need to develop strategies, which will reduce demand for public transport without constraining growth and provide a healthy environment to urban dwellers. Mass transportation systems especially in a few metropolitan cities have moved from construction to the operational stage.

Farsi M et.al, (2006), in their paper applies an ordered discrete choice framework to model fuel choices and patterns of cooking fuel use in urban Indian households. The choices considered are for three main cooking fuels: firewood, kerosene and LPG (liquid petroleum gas). The results show that lack of sufficient income is one of the main factors that retard households from using cleaner fuels, which usually also require the purchase of relatively expensive equipments. The results also indicate that households are sensitive to LPG prices. In addition to income and price, several socio-demographic factors such as education and sex of the head of the household are also found to be important in determining household fuel choice. In contrast to rural households, urban ones often have a wider choice and greater availability and accessibility to modern commercial fuels, electricity, and energy using end-use equipment and appliances, and therefore, greater potential for fuel switching. The rapid growth of urban areas in developing countries has been accompanied by a huge surge in the demand for household fuels and electricity. Changing urban lifestyles have important implications for the quantum and pattern of energy use in households residing in these areas and suggest various avenues for policy relevant research. In addition, an understanding of factors affecting fuel choices in urban households might also provide insights into how rural households might behave if supply of commercial fuels and access to markets were not constrained in these areas. In India, household energy is required to meet the needs for cooking and water heating and for lighting

and powering electrical equipment and appliances. As income increases households tend to switch from firewood to kerosene and then LPG (liquid petroleum gas). However, all households do not necessarily switch completely or, in other words, terminate the use of one fuel when taking up the use of another. LPG, when compared to kerosene or firewood, has clear health, environmental and efficiency benefits. From a methodological point of view, this paper differs from previous literature in that we assume that there is a natural order of progression in terms of the choice of fuels based on their efficiency, ease of use, and cleanliness and therefore, we employ an ordered discrete choice framework to model fuel choice. The analysis shows that in the Indian context, such ordered models can be as useful and instructive as non-ordered multinomial models. In other words, there is an order in the distribution of energy shares by the primary fuel that depends to a large extent on the level of income of the household. Firewood and LPG at the two extremes are more likely to be used with kerosene in the middle, than with each other. However, the results also show that in addition to income, there are several socio-demographic factors such as education and sex of the head of the household, which are important in determining the choice of fuels in urban Indian households. The results seem to suggest several reasons why households shift to the use of modern fuels. In urban areas, where firewood is often bought and opportunity costs for collecting wood are high, economic considerations and availability are crucially important in determining fuel choices. Higher incomes increase the ability of households to afford both the equipment and fuel costs of modern fuels like LPG, which are also more widely available in urban areas. Better education increases the awareness of households of the negative health impacts associated with the use of firewood and also the advantages of modern fuel use, in terms of efficiency and convenience. In larger cities and areas where modern fuel supplies are more regularly and

reliably distributed, households are more likely to choose modern fuels and less likely to require back-up or supplemental use of other fuels. In addition, households where women are more empowered are less likely to use less efficient wood. The analysis presented in this paper highlight several other variables in addition to fuel price as affecting fuel choice, this point also to the importance of exploring other policy options than pricing alone.

FUEL CONSUMPTION AMONG TWO-WHEELER OWNERS IN INDIA: AN OVERVIEW

The oil and gas sector in India plays a major role in influencing decision making for all the other important sections of the economy. India's economic growth is closely related to energy demand; therefore the need for oil and gas is projected to grow more, thereby making the sector quite conductive for investment. The first oil deposits in India were discovered in 1889 near the town of Digboi in the state of Assam. Oil extracted from the oil wells is in its crude form and contains many impurities. It is refined in oil refineries before use. India's first oil refinery started working way back in 1901 at Digboi in Assam. It remained the only refinery in the world of India for more than half a century. The first well was completed in 1980 and the Assam Oil Company was established in 1899 to oversee production. At its peak during the Second World War, the Digboi oil fields were producing 7,000 barrels per day.

The consumption pattern of petroleum products such as Motor Spirit (MS) and High Speed Diesel (HSD) has increased significantly except for Superior Kerosene Oil (SKO). The reason for the reducing consumption of SKO is due to the economic advancement where Liquefied Petroleum Gas (LPG) has come up to replace SKO for cooking and for other purposes. In the year 2010-11, HSD was consumed the highest next to Motor Spirit

(MS) while SKO was consumed the lowest. This had continued till the year 2014-15 where HSD was always the highest consumed product next to MS and then SKO's consumption had started reducing since 2012-13 till date.

CHAPTERIZATION

CHAPTER 1: Introduction.

CHAPTER 2: Review of Literature.

CHAPTER 3: Fuel Consumption Among Two-wheeler Owners in India: An Overview

CHAPTER 4: Transport: A General Profile

CHAPTER 5: Pattern of Fuel Consumption Among Private Two Wheeler Owners in Aizawl City: An Empirical Analysis.

CHAPTER 6: Major Findings and Conclusion.

Bibliography

FINDINGS

1. In the field survey, there are 40 male riders and one female rider who owns a bike, 10 male riders and 19 female riders own scooty. Male riders mostly own bikes while female riders mostly own scooty. Besides these, there are also 41 male riders and 13 female riders who know how to ride before owning their vehicle. As such, male riders mostly knew how to ride before owning their vehicle. The study also reveals that while selecting a vehicle for purchase, the consumers choose vehicles based on their model and followed by the price and fuel efficiency. *(Objective No.1)*

2. Majority of the riders has an income of Rs 10000-30000 and the least number of riders have an income of Rs 60000 and above. In general, household income is the key determinant of the number and the sizes of vehicles that households own. It reveals that household size is a significant factor; even though smaller vehicles are also preferred by larger households, lower income groups mostly prefer smaller vehicles. Some of the possible reasons for these preferences are the relative expense of larger vehicles, tax enforcement etc. (*Objective No.2*)

3. The study reveals that amongst the bike riders, their average petrol consumption per week is 3.78 litres and for scooty, it is 1.59 litres. The average expenditure on petrol per week for bike riders is Rs 465.98 and for scooty riders it is Rs 326.90. The average distance covered by bike riders is 10.50 km and for scooty riders it is 8.45 km. Then, the total average weekly petrol consumption for both bikes and scooty is 4.05 litres, the average weekly expenditure on petrol for both bikes and scooty is Rs 408.36 and their average weekly distance covered is 9.65kms. (*Objective No.2*)

4. At present, there are 13 fuel stations and these fuel stations sell Motor Spirit (MS), Extra Premium (XP) and High Speed Diesel (HSD) in their stations. The sale of HSD is higher than the sale of MS, but this does not mean that the number of vehicles consuming HSD is more in Aizawl, what this finding actually presented is that the vehicles consuming HSD are mainly commercial vehicles whose fuel consumptions is much higher that the vehicles consuming MS.(*Objective No.3*)

5. Biakliana Filling Station was the best seller who sold out 2576KL MS type of fuel during the year 2014-15. In the case of HSD, the best seller of Diesel type of fuel was Lalthanzauva Filling Station with 23436KL during the year 2014-15. The total sale of MS type of fuel during the year

2014-15 is 17484KL and the total sale of HSD is 45168KL. (*Objective No.3*)

6. Average weekly expenditure on petrol, below 150CC range is Rs 321.48, 150-250CC is Rs 497.11 and above 250CC range is Rs 203 respectively. In this case, 150-250 CC spends the highest amount of money for petrol. Then again, CC range 150-250CC covered the longest average distance of 10.72 km than the other CC. (*Research questions No.1)*

7. The weekly average expenditure on petrol for employed riders is Rs 436.5 and Rs 295.7 for unemployed riders. The average distance covered for employed riders is 9.7 km and 9.5 km for unemployed riders respectively. This indicates that employed riders run more distances and spent more money on petrol consumption than the unemployed riders. (*Research questions No.2*)

8. Among the vehicles registered in Aizawl city, two-wheelers contributes the largest share every year and the second contributors are LMV.

9. Out of the eight districts, the growth of vehicles is highest in Aizawl every year while the lowest vehicle population is found to be located at Mamit. Lunglei district also contribute a large share in the number of vehicle population next to Aizawl. The other districts viz, Saiha, Champhai, Kolasib, Serchhip and Lawngtlai also continue increasing every year.

10. The consumption of MS increased from 21,744 KL to 31,257 KL during the year 2010-11 to 2014-15 and Diesel increased from 47,150 KL to 62,100 KL in 2010-11 to 2014-15, the consumption of Kerosene remains 7476 KL till 2014-15. Amongst the three fuel types, the consumption of Diesel is highest in Mizoram and next is Motor Spirit.

11. In Mizoram, there were 15 petrol pumps in 2006-07, an increase in vehicles and developmental processes brings about more demand for fuels. In the year 2013-14, the number of petrol pumps has increased to 27.

12. Most of the two-wheeler riders are in the age group 20-29 and only few riders are concentrated in the age group 40 years and above.

13. In the field survey, the Cubic Centimetres (CC) of two-wheelers are classified into three i.e. below 150CC, 150-250CC and 250CC & above respectively. The average weekly petrol consumption of the CC range below 150 is 4.39 litres, the CC range 150-250 is 3.84 litres and the CC range above 250 is 3.80 litres. Thus, CC below 150 consumes the highest amount of petrol in comparison with the other CC and the total average petrol consumption of every CC per week is 4.05 litres.

14. The study also found out that male rider's average weekly distance covered is 10.2 km and for females it is 8.2 km. Then, the average weekly expenditure on petrol for males is Rs 439.1 and for females it is Rs 331.5 respectively. Thus, this shows that male riders run more distances than females in a week and their expenditure on petrol is also more than female riders.

15. The average weekly distance covered by the age group 20-29 is 10.4 km, for age group 30-39 it is 9.9 km and for the age group above 40 years it is 7.1 km respectively. Then, the average weekly expenditure on petrol by the age group 20-29 is Rs 307, for the age group 30-39 it is Rs 642.6 and for the age group 40 years and above it is Rs 255. Therefore, this indicates that the riders in the age group 20-29 cover more distances weekly than the other age groups and that the average weekly expenditure on petrol is highest amongst the age group 30-39.

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