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Effects of CO_2 Emission on Health & Environment: Evidence from fuel ssources in Pakistani Industry

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Abstract

Climate change, resulting from an increasing concentration of Gases (CO_2, SO_2 and NO_2) in the atmosphere caused by the use of fossil fuels in the industry, is now an established phenomenon and its effects on health have been observed in most parts of the world including Pakistan. The environmental concerns of Pakistan are associated with the adverse impact of expansion in population, change in the living norms of individuals, modern advancement and construction of house schemes, increment in transportation, no public awareness of environmental related education, mismanagement of natural resources, widely unplanned urban and industrial expansions are the core hard issues. Studies of air and water have revealed an alarming air quality especially in most urban and industrial areas and also serious deterioration of surface and ground water quality was identified. The reason for this degradation is emission of CO_2 from the industrial sector. This investigation is to identify the contribution in fuel sources like solid, liquid and gas in the industries with overall emission of CO_2 in the atmosphere and its impact on human health.

Keywords: CO_2 Emission, Health Hazards, Fuels, Particulate Matter, Tukey HSD

1. INTRODUCTION

Pollution can take many forms. The air we breathe, the water we drink, the ground where we grow our food, and even the increasing noise we hear every day, all contribute to health problems and a lower quality of life.

1.1 Climate Change: Climate changeis a statistical distribution change resulting from an increasing concentration of Greenhouse Gases (GHGs) in the atmosphere has become an accepted and major theme in today‘s world, that range from decades to millions of years. The impacts of climate change include biodiversity losses, rise in the sea level, shifts in the weather patterns, changes in freshwater supply and an increase in extreme weather events such as floods and droughts as well as glacial melting and various health impacts. Major concerns are threat to health, water and air security. It is important to note that

some levels of GHGs are also necessary to maintain temperatures needed to sustain human and animal life.

Pakistan's contribution to Climate Change (CC) is very little. In terms of per capita GHG emissions, it ranks 135th among the countries of the world (annual emissions was 309 million tones CO_2 equivalent in year 2013 which was 0.45% of world's total). However, the low carbon emission status of the country provides no safety from impacts of climate change. Nation must understand its local context and responsibilities and create a sustainable strategy for climate change mitigation and adaptation [1].

1.2 Possible health effects: Major fears from CO_2 emission are, Malaria, many types of flies, increased incidences of pneumonia, heat stokes, cholera, dengue fever & heart attacks. CO_2 emission in the air makes 'cloud or umbrella' effect in the atmosphere resulting in the temperature rise which affects human health as well as the social development also suffers from outbreak of vector borne diseases, coupled with malnutrition caused by food and water insecurity.

1.3 Objective of the study: Thisstudy would reveal the possible major impacts due to release of CO_2 in account for environmental conditions on health through air intake and water. Also analysis would look in to the patterns of CO_2 in past and possible advance preventive solution for easy availability of clean drinking water, better sanitary and sewerage facilities, more protected homes against severe weather conditions, and an improved healthcare system.

2. LITERATURE REVIEW

Throughout the most recent 150 years, carbon dioxide (CO_2) on the planet have climbed from 280 to about 380 parts per million (ppm). The human exercises are in charge of the expanded CO_2. The CO_2 fixation has expanded because of smoldering of fossil fuels and blazing of forested area at a phenomenal rate, in this way changing over natural carbon into CO_2 and thus the earth has been warming because of Greenhouse impact. Give us a chance to study the how carbon, sulfur and water offset in nature.

Compelling temperatures can straightforwardly cause the death toll as warm temperatures can build air and water contamination, which thus hurt human wellbeing. To a great degree hot temperatures expand the human deaths. Different effects incorporate those that offer climb to water and nourishment borne diseases. Case in point frequency of intestinal sickness and dengue fever may expand with the increment in temperature and mugginess. Furthermore frequency of pneumonia, hotness stroke, cholera, and heart assault might likewise increment. Other viral and dust illnesses have additionally been accounted for to end up more regular because of expansion in Pollution [2].

2.1 Carbon Cycle: Carbon, nitrogen, oxygen, hydrogen, sulfur & water can exist as dissolvable and in unstable structures and have a full cycle of development between the air, the water and the land. An alternate angle is additionally that the decayed mixes may be mineralized to CO_2 and water, or to natural compound, for example, methane or acidic acid.

Oxygen and carbon are inseparably connected through the carbon cycle furthermore carbon, hydrogen and oxygen can exist as dissolved and vaporous mixes. Large amounts of CO_2 are held in the aquatic repository (Ocean) and this CO_2 communicates and change constantly with environment.

One of the critical responses of the carbon cycle is an established reason for water contamination. Lakes and streams assimilate oxygen from environment while microorganisms at the same time devour

dissolved oxygen and carbon from water. This diminishes the disintegrated oxygen and can jeopardize the fish and other oceanic creatures.

This watery arrangement turns litmus from blue to pink. It is really the anhydride of carbonic acid, an acid which is temperamental in watery arrangement; its PH worth exists in 4.5 to 5.6, from which it can't be concentrated. In organisms carbonic acid generation is catalyzed by the protein, carbonic anhydrase.

Carbonic acid is utilized as a part of the making of soda drinks, cheap and artificial carbonated wines, and other bubbly beverages.

Carbonic acid also structures because of the response,

$$H_2O + CO_2 \text{ ----> } H_2CO_3$$

The expansion of two equivalents of water to CO_2 would give ortho-carbonic acid, $C(OH)_4$, which is insignificant in aqueous arrangement [3].

2.2 Harmful Effects of CO_2

Exposure to CO_2 can create a mixture of wellbeing impacts. These may incorporate cerebral pains, unsteadiness, sticks or needles feeling, trouble breathing, sweating, tiredness, expanded heart rate, lifted circulatory strain, unconsciousness, asphyxia, and shakings [4].

The most well known impact of carbon dioxide is its stimulant activity upon breathing in. The respiratory framework goes about as a physiologic cushion framework [5] .Greatly raised carbon dioxide focuses can prompt respiratory acidosis if the limit of the blood buffering framework is surpassed. Accordingly, respiratory discharge of carbon dioxide happens quickly through an increment in the ventilation rate [6].

A fleeting introduction of 17 to 32 minutes of people to 1 or 2 percent carbon dioxide has been demonstrated to cause a slight increment in systolic and diastolic weight [7]. A convergance of 3 percent carbon dioxide delivered cerebral pain, diffuse sweating, and dyspnea at complete rest after an exposure time of a few hours [8].

Introduction to a centralization of 6 percent carbon dioxide can create and visual aggravations inside 1 to 2 minutes [9]. Intense exposures (minutes) to 6 percent carbon dioxide influenced vision by diminishing visual power separation in 1 to 2 minutes and brought about 3 to 8 percent diminish in hearing [8].

Introduction to higher range of 10 to 15 percent carbon dioxide prompts discombobulation, tiredness, extreme muscle jerking, and unconciousness inside a moment to a few minutes. Intense exposures to higher concentration of carbon dioxide (30 to 70 percent carbon dioxide for 38 seconds) may bring about electrocardiogram changes [10].

Notwithstanding its physiological impacts, CO_2 can likewise go about as an asphyxiant by removing O_2. Indications of asphyxia will be noted when environmental O_2 $\leq$16%, unconsciousness prompting demise will happen when the O_2 mix is decreased to $\leq$8% [11].

Carbon dioxide likewise influences the circulatory system. On the off chance that, the content of carbon dioxide in the air builds, the body will remunerate by expanding the respiratory depth and rate

with a going hand in hand with expansion in heart yield. Treatment to high exposures of this compound includes expelling the victimized person from the restricted space or oxygen deficient environment, and expanding the oxygen supply to the uncovered individual. The state of acidosis is reversible upon expulsion from a high CO_2 environment [12].

Epidemiological studies have been performed to watch human danger to CO_2. Inside 1 minute of introduction to 20-30% CO_2 blatancy and writhing happen in people. Neurologic side effects including eye and furthest point twitching, and writhing have been seen in people after CO_2 exposure. The measure of carbon dioxide in a building is typically identified with what amount outside air is consistently brought into that building. As a rule, the higher the CO_2 level in the building, lower the measure of natural air trade. In this way, looking at levels of CO_2 in indoor air can uncover if the warming, ventilation, and cooling (HVAC) frameworks are working inside the defined rules. CO2 levels are normally measured in percent (%) of air or parts per million (ppm) [13].

High CO_2 levels, for the most part in excess of 1000 ppm, demonstrate a potential issue with air flow and natural air in a room or building. When all is said in done, high CO_2 levels show the need to analyze the HVAC framework. High carbon dioxide levels can result in poor air quality and can even smother pilot lights on gas-fueled machines. The utilization of dry ice in the work spot can hoist indoor CO_2, if the air is not ventilated [14].

For quite a long time, diggers have been mindful of the word related risk of "dark moist," a condition of low oxygen levels in mine poles. It was regular for excavators to send a flame or mouse into the mine before entering and look for the candle to extinguish or the mouse to lose cognizance, demonstrating an absence of oxygen, consequently, a poor work environment [13].

Yeast discharges CO_2 as a repercussion at the present time maturing liquor. Brewers entering encased regions, for example, cleaning out tanks subsequent to fermentation could be overcome by elevated amounts of CO_2 [15]. A study on bottling works specialists established that they are presented to 1.08% over a 8-hour workday generally speaking [4].

CO_2 is additionally a result of metabolic action of natural grains. Subsequently, human working in grain lifts and storehouses, where put away grain delivers 37% CO_2 amid oxidation of carbohydrates, are at danger for abnormal amounts of CO_2 presentation [8].

From long haul introduction to 3% CO_2, submarine laborers have demonstrated manifestations, for example, flushing of the skin, a fall in circulatory strain, and diminished oxygen utilization. On the other hand, long haul introduction to low centralizations of CO_2 has not brought about suffocation but versatile physiological systems to long haul presentation have been accounted for [15].

A study of different aspects with human volunteers was conducted to study the physiological impacts of unexpected exposures to 10 percent oxygen with 4 percent carbon dioxide. Their results demonstrated that a higher end tidal oxygen incomplete weight, expanded ventilation, marginally lower

heart rate, stable hemoglobin immersion (over 90 percent), higher center cerebral vein blood speed, and expanded (above typical) cerebrum oxygenation stream [16].

An investigation of blood vessel and inside jugular blood oxygen, carbon dioxide substance, and cerebrum work in youngsters who inhaled mixtures containing low rates of oxygen and shifting degrees of carbon dioxide showed that normal brain function can be kept up for short a time disregarding low rates of oxygen in the inspired air (as low as 2 percent oxygen) [7].

3. ENVIRONMENT: THE STATUS OF PAKISTAN DUE TO INDUSTRIES

The industries involved in the CO_2 outflow can be grouped as solid, fluid and vaporous waste. Solid and dangerous waste is creating incredible harm to Pakistan's delicate eco-framework, because of absence of administration and transfer techniques, therefore prompting, serious low quality air, contaminated ground water, drinking water, surface water in major urban cities and river system**.**

3.1Types of waste from Industries: Acids, heavy metals solvents , acids, silver cadmium, minerals acid solvents, inks, dyes solvents, chromium, Rig mud, spent catalysts, oily waste, tarry residues, solvents, mercury etc are among many types of wastage industries usually produce .Few more in the list are used fluorescent tubes, batteries, paper, drugs, cosmetics, clothes, paint, wood, glass, vehicles care materials, cell phones, wires, polythene bags, Oil, hydraulic fluids, halogenated solvents, polychlorinated, Biphenyls (PCBs), tires and plastic etc. Hospitals come under public sector also produce Infected human tissues, organs, excreta, blood, sharp instruments, laboratory equipment and tissue cultures drugs.

Improper disposal of untreated industrial water have contaminated the drinking water along with the heavy metals. In most of the urban and rural population water is supplied from the ground water (about 68%).The country is exposed to the hazards of drinking unsafe and polluted water from both surface and ground water sources, it posses potential risk to public health [1].

3.1 State of Air in Pakistan: Air quality data recorded in cities confirmed presence of high concentration of suspended particulate matter in air (2-3.5 times higher than the safe limit). Oxides of Carbon are continuously increasing in major cities. The level of PM (particulate matter size below 2.5 micron), which is mainly due to combustion sources, has reached to an alarming point (2 - 3.6 times higher than the safe limit)(Fig 1). The W.H.O. air quality guidelines for PM10 is 20 micrograms per cubic meter (µg/m3) as an annual average, but the data released shows that average PM10 in some cities has reached up to 300 µg/m3.

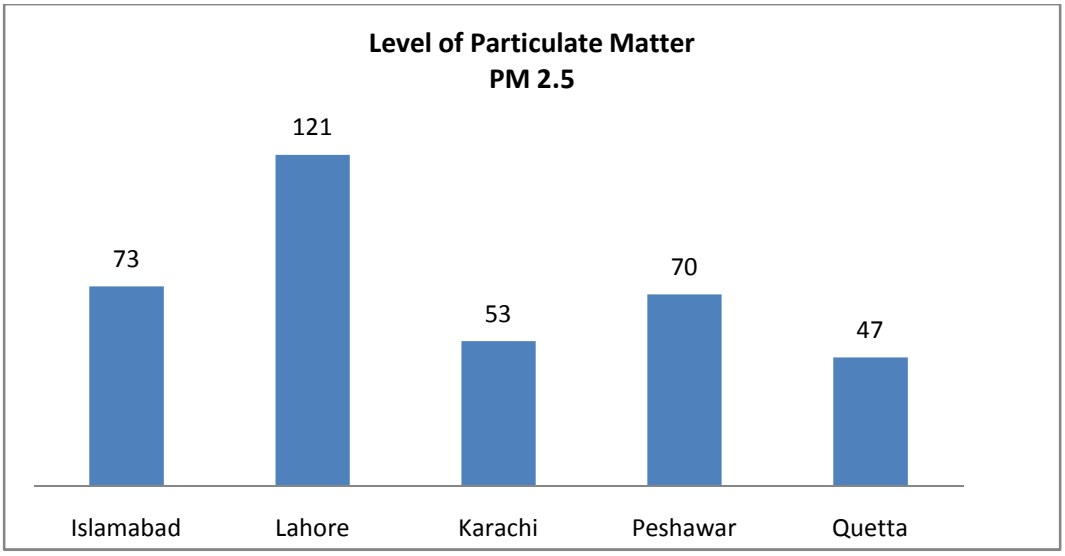


Figure 1: *Level of particulate matter in cities of Pakistan. Source: Hydrocarbon development department, Published: Pakistan economics survey report 2012-13, Ministry of Finance.*

The other causes of air pollution are the abrupt increase in the number of vehicles, inefficient automotive technology and use of unclean fuels. Vehicular emissions in all the major cities of Pakistan are the primary source of air pollution. Motor vehicle emissions (CNG, Petrol, Diesel, LPG Based Engines) account for about 90 % of total emissions of hydrocarbons (smog and carbon monoxide, eventually becomes CO_2), all of which have dangerous health implications, especially in densely populated urban centers [17].

3.2 State of Water in Pakistan: Water is a key which makes an extension between the financial profit zones including farming, forestry, health, energy, human settlement and water cycle in the environment. The individuals who need water security (counting security from water-related fiascos) are overwhelmingly liable to be poor and be living in geologically separated debased areas.

Pakistan confronts enormous drop of surface and ground water quality in perspective of un-subside modern, metropolitan and cultivating contamination. Without the recognition and weak authoritative prerequisites, watering framework conduits and streams have been completely dirtied. The unpredictable arrival of untreated waste water, city sewage and unchecked plant overflows is dynamically dirtying watering framework, land and organic sea life. Organizations also discharge waste water into water bodies, around 9000 million gallons of waste water discharge into water bodies, consequently this is provoking great contamination of ground & surface water.

According to investigation by Commission of Health & Services of Pakistan, the drinking water was debased with So4, No3, and overwhelming metals, for example, Pb, Cd, Fe, Ni and Zn. Furthermore drinking water likewise contaminated with coliform bacteria. It is also revealed that, out of an aggregate 357 water sources, just 45 (13%) were discovered "safe" and the staying 312 (87%) were "dangerous" for drinking reason [17].

4. METHODOLOGY

4.1Samples: The sample comprises of the emission of CO_2 from industries from all over the Pakistan. The industries were divided into groups on the basis of classification of fuel i.e. solid, liquid or gas, they used in their system.

To obtain CO_2 values that are averaged for the whole atmospheric column (the total volume of air over a certain area), the solar spectrum needs to be measured on the earth's surface at a monitoring site and from space, with a satellite such as the Greenhouse Gases Observing Satellite (GOSAT).

4.2 Statistical Analysis:

The data were tabulated on Microsoft Excel Sheet and then it was imported to SPSS for analysis. Multiple comparisons were performed in order to find out the relation between the solid fuel, liquid fuel and gaseous fuel. The purpose of Tukey's HSD test is to determine which groups in the sample differ. ANOVA procedure was used to decompose the total emission variance into the corresponding sources of emission.

Table 1shows over all emission of CO_2 in Pakistan which is about 0.5% of the total emission in the world. It can easily be seen that there is significance change in emission has occurred if consider the year 1985 the total emission was 47.176 million tons of carbon and in the year 2010 the total emission was recorded as 161.39 million tons.

Table 1: *Emission of CO_2 from the industries using Solid fuel, Liquid fuel and Gaseous fuel.*

Year	CO2(MT)	Gaseous Fuel (MT)	Liquid Fuel(MT)	Solid Fuel(MT)
2010	161.3957	0.066695	0.062299	0.01744
2009	157.89	0.067044	0.058357	0.018526
2008	156.6762	0.065808	0.058976	0.018925
2007	158.8948	0.065005	0.057924	0.023128
2006	146.0749	0.063809	0.054264	0.017704
2005	136.6361	0.063549	0.048404	0.016204
2004	131.6013	0.060828	0.046373	0.01692
2003	118.8951	0.054957	0.04425	0.013205
2002	114.084	0.044807	0.053703	0.010088
2001	108.2828	0.037887	0.055133	0.008049
2000	106.4493	0.036399	0.055438	0.008196
1999	100.3841	0.034503	0.052489	0.008599
1998	97.6632	0.032409	0.052621	0.008188
1997	94.7113	0.032244	0.049398	0.008581
1996	94.4473	0.030429	0.05022	0.009366
1995	84.484	0.028133	0.043729	0.008339
1994	84.8397	0.028562	0.043021	0.009215
1993	78.0081	0.026971	0.038415	0.008471
1992	72.79	0.025537	0.035002	0.008368
1991	68.2429	0.024004	0.032339	0.008031
1990	68.5656	0.023135	0.033153	0.008537
1989	60.9565	0.020968	0.029442	0.007088
1988	58.2136	0.018262	0.027352	0.007114
1987	53.5345	0.016799	0.025064	0.006443
1986	49.4532	0.016245	0.022937	0.006274
1985	47.176	0.015486	0.021866	0.005801

Table 2: *Analysis of variance between the fuel groups and* CO_2 *emission and the relationship between the fuel groups.*

ANOVA

Emission Million Tons

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.016	2	.008	47.897	.000
Within Groups	.013	75	.000		
Total	.029	77			

Table 2 shows that there is a statistically significant difference in the emission from one fuel to the other type of fuel of emission.

Table 3*: Differences of Emission Means of fuel group and their significance level with each other.*

Multiple Comparisons

Dependent Variable: Emission Million Tons

	(I) Fuel Type	(J) Fuel Type	Mean Difference (I-J)	Std. Error	Sig.
Tukey HSD	Gaseous Fuel	Liquid Fuel	-.0058344	.0036318	.249
		Solid Fuel	.0274490*	.0036318	.000
	Liquid Fuel	Gaseous Fuel	.0058344	.0036318	.249
		Solid Fuel	.0332834*	.0036318	.000
	Solid Fuel	Gaseous Fuel	-.0274490*	.0036318	.000
		Liquid Fuel	-.0332834*	.0036318	.000

*. The mean difference is significant at the 0.05 level.

Table 3 shows that there is a significant difference between the gaseous fuel and solid fuel as a whole and no significance difference in emission of CO2 between gaseous and liquid fuel.

Table 4: *Differences of Emission Means of fuel group and which emission means are different within the fuel group population.*

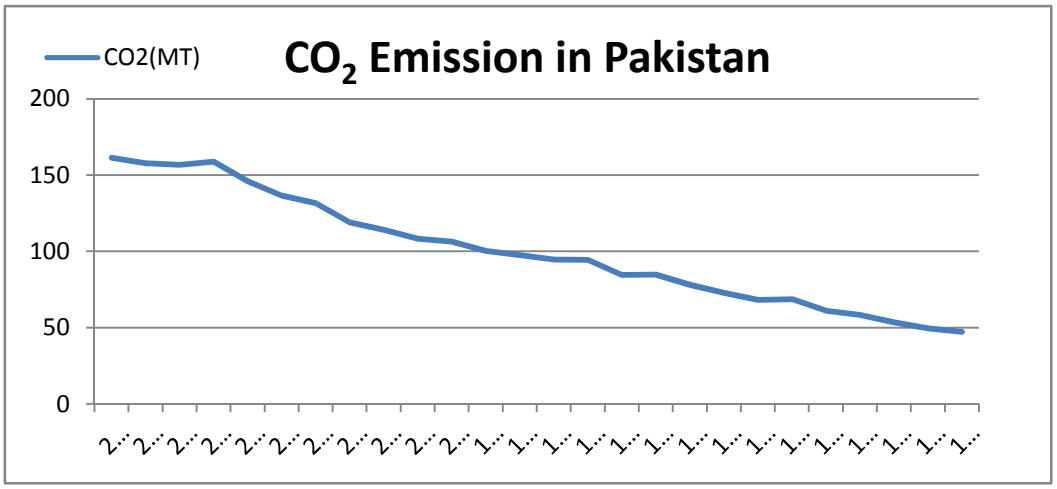
Emission Million Tons

Fuel Type		N	Subset for alpha = 0.05	
			1	2
Tukey HSD[a]	Solid Fuel	26	.011031	
	Gaseous Fuel	26		.038480
	Liquid Fuel	26		.044314
	Sig.		1.000	.249
Tukey B[a]	Solid Fuel	26	.011031	
	Gaseous Fuel	26		.038480
	Liquid Fuel	26		.044314

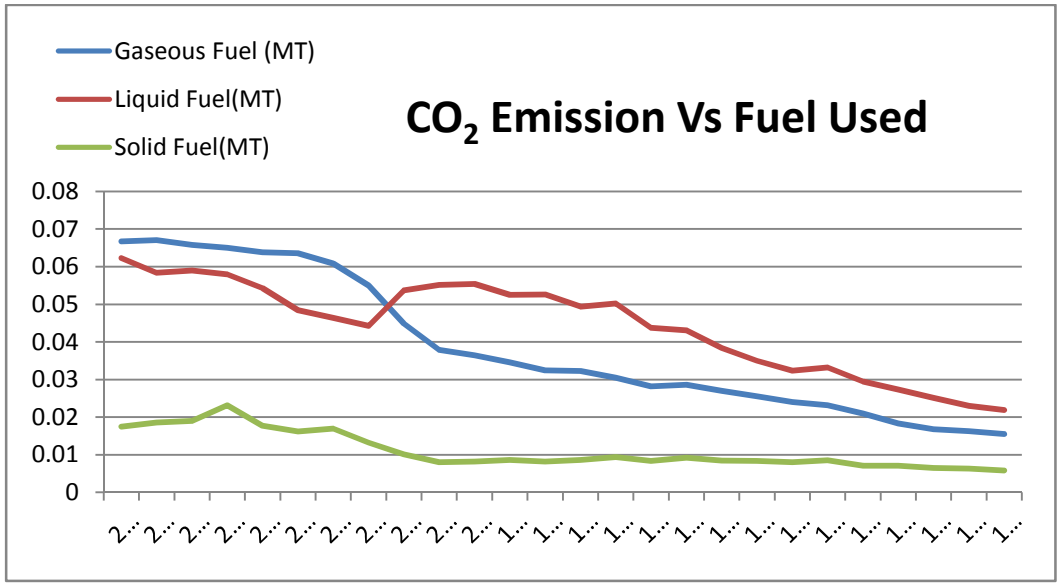
Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 26.000.

Graph 1: *The trend of CO_2 release with in Pakistan from various sources including industrial sector.*



Graph 2: *CO2 Emission in Million tons due to types of fuel Used by Industries of Pakistan.*



5. DISCUSSION

The trend shows that the emission 25 years back was low as 47 million tons but as the years past emission has been growing from the industrial sector. If we consider the 1985 and 1986 than there is an increase of 4 % and if we consider the last 10 years than year 2001 has the 5 % increase then in the year 2000. Further in the 2002 had the upward rate of 5.5 % in CO_2 Emission. Since 2005 till the year 2010 there is average increase of CO_2 in Pakistan due to development of industrial and other sectors. On the other hand if consider the usage of gaseous fuel, it can also be predicted that there is increase in consumption of solid fuel, consequently there is an increase in CO_2 emission.

Considering the year 1985 and 2010 there is an increase up to 434 % of CO_2 emissions only due to the gaseous fuel only. The trend shows that emission of CO_2 remain at the level of 0.025 million of tons from 1985 and carried the same way till the year 1995. From the year 1996, the CO_2 emission went up to the rate of 8.3 % per year till the 2001. Than onwards, 2002, there is jump of 18% in emissions of CO_2 till the 2003. Since 2004, the CO_2 emission level further gone ahead of 10.6 % rate each year till the year 2009. If we consider the past 26 years than the average up rate of CO_2 emission due to gaseous fuel in industries would be 12.2 % on average each year.

If the liquid fuel is to be considered than in the year 1985 to 2010 than there is an increase of 200% emission. Let's look at the behavior in terms of decades, revealing that since 1985 to 1994 the CO_2 remained at the level of 9.8% increase each year on average. The second decade, 1995 till 2004, the mix trend had been observed. In the 1997, there was the decrease in emissions recorded of about 1.6 % and also 2.5% in the 2002 comparatively from the previous years. Overall effect was recorded as the average rate of emission gone upwards i.e. 1.77 % per year. From the year 2005 till 2010, the only upward trend is predicted of 5.3% on average each in CO_2 emissions.

Coming to another source of fuel which is solid, the trend is same as the other two of about 200% increase is recorded from the year 1985 till the year 2010. If we consider the last five years than the average increase of CO_2 due to solid fuel is 3.07 %. In the recent past solid fuel consumption has been on lower side, back in 2006 the increase was 9.25 % as compared to 2005 and also 35% increase was seen in emission of CO_2 in 2007. But since then decrease in emission was seen up to 21 % in the year 2007. The further decrease of 2 % in 2008 and again 5.9% CO_2 emission decreased recorded in the year 2010.

We reject null hypothesis and conclude that there are differences of emission in different usage of fuel type but we don't know which of the three means might be different. The value of 0.029 is referred to as the total sum of squares for the sample variance. The examination addresses the amount of emission between the fuel groups (Three groups) with respect to the variation within the fuel groups (0.013). Relatively large portion of variation is explained by the emission effect, the sums of squares for the fuel groups are 0.008.

A large ratio of the mean squares (the F-statistic) implies that the amount of variation explained by 'between fuel group' is large in comparison with in group. The F-statistic is 47.897, with an associated p-value of 0.000. Since the p-value is too small, the fuel groups (Solid, Liquid & Gaseous) effect is statistically significant. Therefore, the different state of fuels emission is an important factor for consideration. We can relate that there is no significant difference in emission of CO_2 between the gaseous fuel and the liquid fuel (0.249), but there is significant difference of CO_2 emission between gaseous and solid fuel (0.000).

If we consider the liquid fuel, than there is a significant difference in emission of CO_2 with solid fuel (0.000), but no significant difference with gaseous fuel (0.249). Most importantly there is significant difference of CO_2 emission of solid with gaseous fuel (0.000) and liquid fuel (0.000).

The study provides insight into the relationship between type of fuel and CO_2 emission and also relationship between the industrial wastes with health of the citizen of the country. The knowledge regarding the CO_2 emission due to fuel utilized in the industries is directly causing the change in the air and also in the water system. Similarly the types of fuel used are independent of each other irrespective of their applications in the industries but all fuel groups are independent and causing the CO_2 release in to the air and water. The research also sheds light in to the dynamical impact of CO_2 on human health, therefore future researches should be conducted to understand how industries can adapt and review their practices of fuel used and how should the citizens of Pakistan tackle the situation.

6. CONCLUSION

There is a significant difference of emission of the fuels and they differ with each other significantly in terms of CO_2 emissions. In the light of the discussion above it can be observed that the emission of CO2 has increased significantly and to which the fuel sources have played a significant role. The air quality in the cities is already gauging to the maximum level of the allowed limit of the particulates and also Pakistan is considered as water stressed country already, not only in unavailability of water but also the polluted water supplies to its citizens, as per international standards. Pakistan must have to seek the healthier eco system for its citizens as CO2 cycle has a negative impact on human specially on the communities living nearby the industrial sectors.

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