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ARTICLE

Climate Change Impacts on Water Resource and Air Pollution in Kabul Sub-basins, Afghanistan

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ABSTRACT

This Climate Change Impacts on Water Resources and Air Pollution, research is carried out to analysis Hydro-meteorological and groundwater data in Kabul Sub-basins, Afghanistan. The main objective of this research is to find out natural causes of climate change effects on surface and to, groundwater resources and air pollutions, these data are collected from diferent Hydrometeoroiogical stations and observations in Kabul Sub-basins for different years (1957 to 2017). For completion this research they used two categories of data analysis; one is hydro meteorological analysis, and the other is groundwater level analysis. In hydro meteorological analysis air temperature, rainfall and discharge have been recovered by this research in Kabul Sub-basins, a number of air temperature, rainfall, discharge of surface water and groundwater are changes due to climate changes from 1957 to 2017. For climate changes effects this article used air pollution data of national, international development bank of Asia, WHO standards and parameters; $PM_{2.5}$, PM_{10}, TSP, NO_2, SO_2, O_3, CO and Pb. From comparing PM_{10} are very higher in the air of Afghanistan. The discharge of Panjsher river due to glacier melting and climate changes increasing. The challenges during this research are lack of equipment.

1. Introduction

Afghanistan is a country dominated by a dry climate, with most of the area categorized by effects of global climate changes on hydrological systems, particularly on mountain snow and glacier melting, can adapt the timing and quantity of water stream in mountain watersheds. So, correct stream current simulation and prediction is of great importance to water resources management and forecasting [24].

Therefore, lake of snow and ice in mountain regions might have faraway-reaching economic, environmental and community implications. Overflow due to snowmelt from mountain regions is significant for continued water supply. Snow is therefore vital water resources, for the reason that dissimilar precipitation, it's released gradually in the form of melt water over a long period and provide supportable streams throughout dry periods to achieve the water necessities. The presence of snow in a basin strongly effects the moisture that is deposited at the surface and is accessible for future runoff [4,24].

The hydrology of mountains regions is largely

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dependent on the climate conditions of the regions, as mountains usually received large amounts of precipitation, which maybe storage in the form of snow. Mountains also represent unique areas for the detection of climate change and the assessment of climate related impacts. Climate change is expected to contribute to the increased variability of river runoff due to changes in the timing and intensity of precipitation and snow melting [19,25].

The key watercourses drain at the snowmelting times (from January to May), rainy periods (March to April) and occasionally through quick overflowing terms (May to August), the main elevations of snow cover are Parwan Maintains series, Wardak, Loger, Baba, Spingher, Salang, Kohkurugh, Koha Safi, Hindu Kush mountains ranges in Afghanistan" [19], as well as here are certain cold provinces for example, Bamyan, Wardak, Loger, Badakhshan, Pangesher, Parwan and some parts of Kabul, snow covers of these areas from September to November and its storing for water resource in Afghanistan [18,19,24].

Likewise, in north sides of Afghanistan, here are specific glaciers; Pamir Badakhshan, Mymai Badakhshan, Panjsher mountains range that belongs to the Hindu Kush mountains series in Afghanistan. These are main sources for Panjsher, Helmand and Kuner Rivers [17]. In particular provinces, we use rivers as a mean for irrigations and water supply (Drinking water), such as Bamyan, Panjsher, Wardak, Parwan, Helmand and Kandahar, Kapesa, but in some of these provinces for instance, Wardak, Parwan, Panjsher spending from spring, and in several provinces use for drinking and irrigation benefit from Kariz water, and some other provinces benefit from wells [16].

Currently 4.14 million people are living in Kabul City [4], increase of population in Kabul lead to unplanned houses, water shortage, environmental and other social-economic problems [8-10]. Recently, the rapid population growth and climate change impacts have placed new stresses on environmental pollution, especially on air pollution and water resources deletion [14]. Over period the of 1960 to 2008, the mean annual temperature high of Afghanistan increased by 0.6°C with an average increase of 0.13°C per decade; and the mean annual precipitation decreased at an average rate of 0.5 mm per month with an average decrease of 2% per decade [1,2].

The geographical location and Inversion processes in winter season, concentration of population and increasing vehicles, old vehicles, raw road, clinics, using plastics in cooking are all phenomenon those are increasing the amount of PM_{10} and $PM_{2.5}$. The annual quantities of PM_{10} increasing in Kabul and in all bigger provinces of Afghanistan [13]. The increasing amount of SO_2, in Kabul province according to the WHO has been lower than the standard condition. Also the amount of NO_2 at the Kabul air is lower than WHO standards. As well as in Kabul city the amount of all populated risky such as aromatic ring of hydrocarbon, that is exist suspended in air are also smaller from toxic limits [5,7].

A comprehensive analysis of air pollution in Kabul has not yet been conducted. However, there have been measurements to calculate levels of particulate substance, oxides of nitrogen, oxides of sulfur and carbon monoxide. The main sources of air pollution include old cars, poor quality fuel, and people burning trash, industrial brick kilns, small-scale smelting plants and foundries [21, 23]. That's in addition to pollution coming from bakeries, restaurants and wedding halls, power plants, generators, household cooking stoves and heaters [6].

From view point of geology the amount of sediments in Kabul Basins closely belongs to climate change effects. Because the different geology sediments carried from Paghman, Aliabad, Asmayie, Qorugh and Logger mountains and the amount of sediments shortage year to another year [20]. These sediments carried from surrounding mountains by water at the diverse periods of time and made different thickness. In the upper and middle parts of Kabul in terraces accumulated some heavy and light minerals, and these minerals belongs to mother rocks that located at the surrounding mountains areas of Kabul Basin [15]. All rivers of Kabul Basin joined at the different locations and flowing from west to east, sediments of Kabul Basin belongs to Tertiary (Eocene and Oligocene) but the amount of rivers flows shortage due to climate changes, the age of sediments between upper and middle parts of Kabul is about 20 - 45 millions years, which called Tertiary formations [17]. All surrounding mountains of Kabul Province, made by metamorphic rocks, without Paghman Mountains in adaption metamorphic rocks. From Radiometry method they found the life time of these mountains are about 928±8 million years ago [15]. The older one is located at the Khair Khana Mountains and the younger is in Shawaky and Qorugh mountains ranges [22].

Geographical Location

The areas of Kabul province consist of Kharkhana, Hazara Baghal, Khajrawash, south side Charasiab, east side Polycharkhay, Tankgaru and Phaghman mountains [25]. The Kabul province divided into 22 wards and every ward divided into different parts. Generally, Kabul old province, which is area about 344 km^2, and the Kabul new province area 740 km^2, and Kabul province area is 1084 km^2 [12,26].

From research we found that, the Kabul province is from north to south 13 km and from east to west 22 km, bigger (Figure 1) [27].

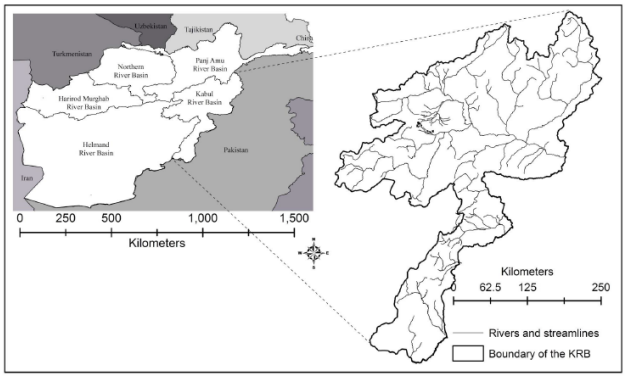

Figure 1. Location map of Kabul Sub - basins, Afghanistan.

2. Methods and Materials

For complication this research we used three categories of hydrometeorological, groundwater and air pollution data analysis. In hydrometeorological analysis involves air temperature, rainfall and discharge data analysis, in groundwater involves groundwater fluctuations for 2005 to 2017 and for 2007 to 2012 balance between recharge, discharge, precipitation in groundwater and in air pollution parameters consist of $PM_{2.5}$, PM_{10}, TSP, NO_2, SO_2, O_3, CO and Pb analysis. In this research they analyzed the different kinds of data, its consist of hydrometeorological, groundwater and air pollution we done for climate changes from 1957 to 2017, and its effects on air temperature, precipitation, groundwater drawdown and air pollution.

In this research we measure dissimilar data of hydrometeorological, groundwater and air pollution as it's explained in the different figures (Figures 2-31) and Tables (1, 2, 3 and 4) at the Kabul sub-basins, Kabul, Afghanistan.

The Aim of Research

The aim of this research is to analyzed different data of hydrometeorological, groundwater and air pollution, for climate changes from 1957 to 2017, and its effects on air temperature, precipitation, groundwater drawdown and air pollution.

3. Results

In Afghanistan from last three decades climate change closely effects on air temperature, precipitation, surface water flows, groundwater resources and air pollution. Its special effects on the human lives, because more populations using water for drinking and irrigation systems. Some rivers such as Kabul, Loger and Paghman are dry and they we cannot use for irrigation uses. But some rivers of Afghanistan like Panjsher and Kunar river, due to climate change warming air temperature glaciers melting increasing year by year. Due to climate change in 2020 floods from blast of Glacier Lake at Panjsher province and more agriculture land and villages are destroyed. From 2000 to 2020 we have some floods in Kabul, Loger, Paghman Rivers due to its destroyed villages, as well as agricultural lands in Kabul, Kapisa, Wardak and Loger provinces due to floods destroyed. The six standards of air: PM, NO_2, SO_2, O_3, CO, and Pb also at the air changes, which the amount of PM_{10} in the air of Afghanistan is very higher. The main reasons of these are climate change in Afghanistan, which we can see in Figure 2 to Figure 31.

3.1 Meteorological Characteristics

3.1.1 Air temperature

The climate of Afghanistan is simi-arid, wind direction are flows from north toward south, and it is started from Hindu Kush Mountains Ranges. The hydro-meteorological situations in the winter seasons belongs to snow fall and at the spring seasons to rain fall, the amount of whole annual precipitation is 300 - 400 mm, and at Salang Mountain total annual precipitation is 800-1000 mm, the higher mean air temperature is between 25-30 C^o at the summer season, and lower air temperature winter season is -25 at the Salang and at the Jabal Saraj is -5 to -10 C^o. The landscape of Parwan Province has been formed from mountains, the main mountains of Parwan province is Salang and Pangesher mountains to plain areas of Kohdaman, the Hindu Kush mountains range are like wall at the north part of this province continues. The Jabal Saraj, Dowshakh and Paghman mountains ranges are located at the west side of this province [19]. In Kabul River basins we having 25 meteorological stations at the different locations of those basins, for better understanding we can find from Digital Elevation Model (DEM) of meteorological stations in Kabul river basins (Figure 2).

From the different research clear that, in Kabul city the main causes of climate change result increasing the air temperature in Kabul are directly related to the pollution of Kabul, because from many years drought the Kabul province air collected different type of gases of CO_2, CO, dust, and others changing consist of discharge rate from many years, those are clear in Figures 11 to 24.

From annual mean temperature 1958 to 2010 we can find the air temperature increasing, the main reasons of these are involved climate change, that effects on temperature (Figure 3). There are1971 to 1983 very lower temperature and if we compare to the precipitation is also

lower but on in 1972 we having some precipitation which is 40.7 mm.

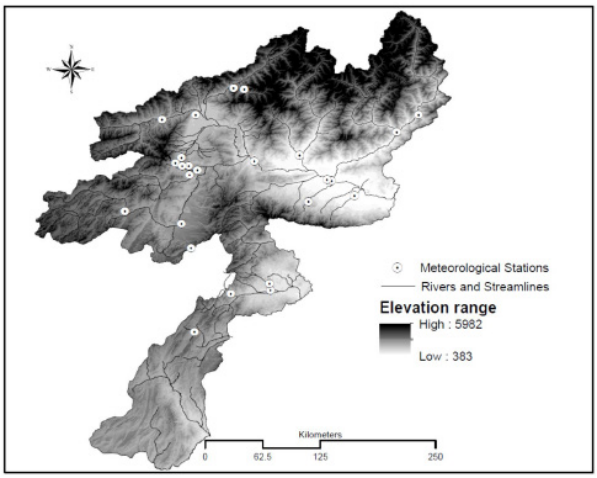

Figure 2. Elevation model of meteorological stations in Kabul river basins.

Because no any mean annually precipitation are the normally from 2010 to 2017 and there is not any change fluctuation in air temperature at the Sangi Nawshta meteorological station (Figure 4).

Monthly mean air temperature from 1958-1983 and 2002-2010 in Parwan Meteorological station province. The mean monthly air temperature from November to August is higher but, the higher peak of air temperature is in March and April, which call the hot months of year (Figure 5).

3.2 Precipitation

If we consider the annually rainfall trend from 1957-1983, in Omarzai meteorological station, its decreasing from 1957 to 1983. The main reasons are climate change effects (Figure 6), and the maximum amount of precipitation are 65,72 mm and 81 mm, in 1959, 1965 and 1972 years. These abnormal changes of precipitation belongs to the climate changes, that its effects on hydro-meteorological conditions.

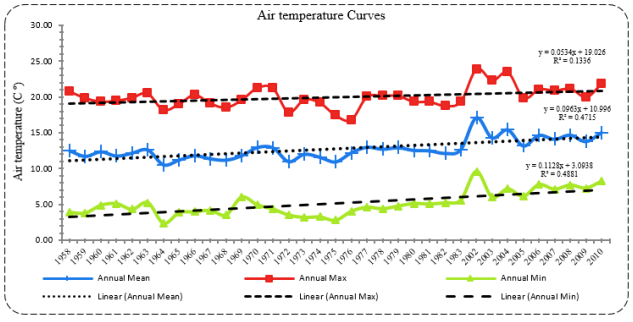

Figure 3. Annually maximum, minimum and mean air temperatures and its trines from 1958 – 2010 Kabul airport, Kabul province.

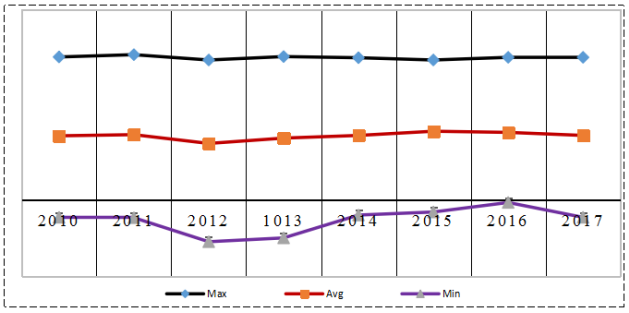

Figure 4. Balance maximum, minimum and mean air temperatures from 2010 – 2017 Sangi Nawshta meteorological station, Kabul province.

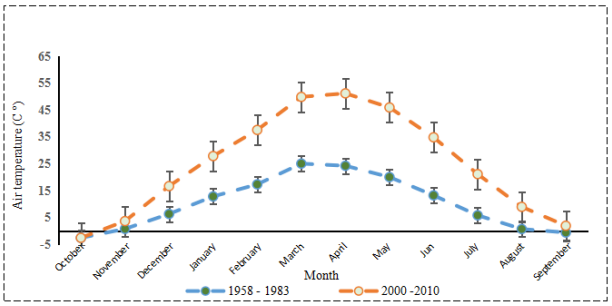

Figure 5. Monthly mean air temperature from 1958-1983 and 2002-2010 in Parwan Meteorological Station province.

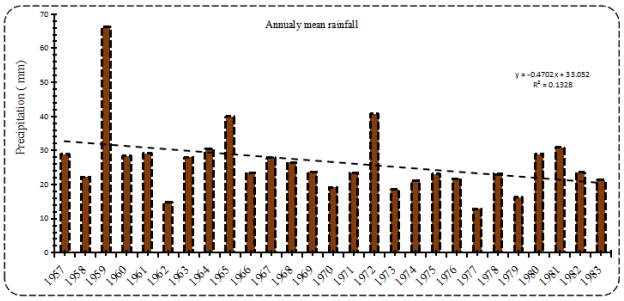

Figure 6. Annually rainfall trend from 1957 - 1983 in Omarzai meteorological station.

The annually mean total rainfall from 2003-2010 in Sangi Nawshta Meteorological station, in Kabul province, are also abnormal due to climate change and these only occurs in winter seasons (Figure 7). In duration many years the amount of precipitation are very lower and are about 35 mm.

The Annually maximum and totally annual precipitation from 2010 to 2017 in the Omarzai Station. There are more precipitation in 2010 and 2014, which are 396 mm and 386 mm respectively. But the lower precipitation rate is 2013 which rate is 271 mm (Figure 8).

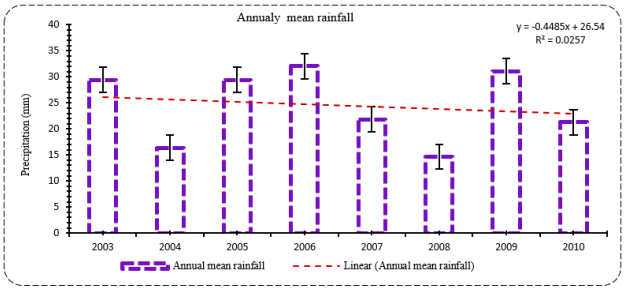

Figure 7. Annually mean rainfall from 2003 - 2010 in Sangi Nawshta Meteorological station, Kabul Province.

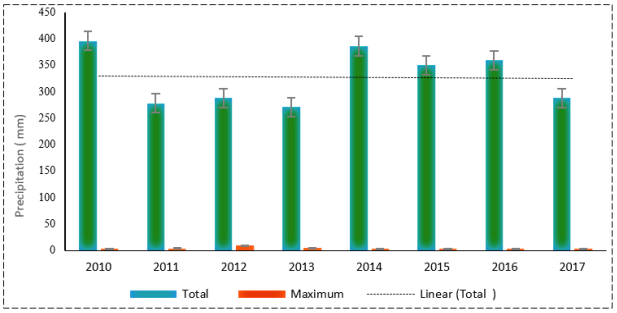

Figure 8. Annually maximum and totally precipitation from 2010 to 2017 in the Qalay Malik Station.

Monthly precipitation changes from 1958-1983 and 2003-2010 in the Omarzai Station. The higher precipitation is in winter seasons, from February to March and from June-October is lower precipitation due to summer seasons. Because in Afghanistan the more precipitation occurs in winter seasons, in summer seasons we not having any precipitation (Figure 9).

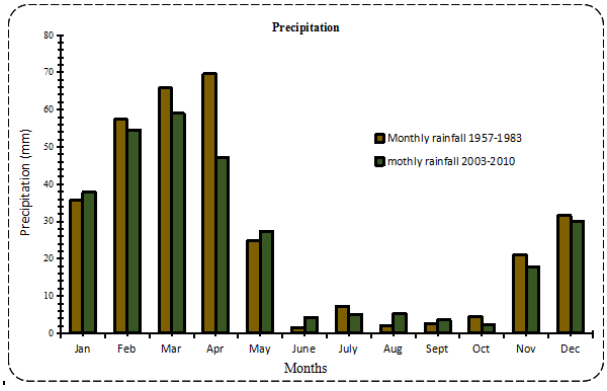

Figure 9. Monthly precipitation changes from 1958-1983 and 2003-2010 in the Omarzai Station.

3.3 Water Resources

3.3.1 Surface Water

Afghanistan is one of the country its surface water flowing belongs to precipitation and snowmelting seasons. As in Afghanistan we have three type of rivers, first one is flowing at the four seasons of year from glaciers areas (Hundu kush mountains range) in Afghanistan, such as Helmand, Kuner and Panjsher, the second one is only in snowmelting seasons, winter snow fall and rains such as Kabul, Loger, Paghman rivers, but the end third one is belongs to sudden floods such as mountains valleys, that occurs in summer seasons. Due to continuing climate changes, and lack of precipitation all rivers water came down, some dry rivers effects on agriculture land are related to condition of drought. In some places we use surface water for drinking and irrigation, as well as we use Kariz, springs and wells, but it are also in the condition of drying. The main rivers of Afghanistan are Kunar, Kabul, Loger, Panjsher, Alishing, Alingar, Ghorband, Shamal and Gumal Rivers, and the main river basins are Amu Darya, Northern, Harirud Marghab, Kabul (Indus), and Helmand (Figures 10).

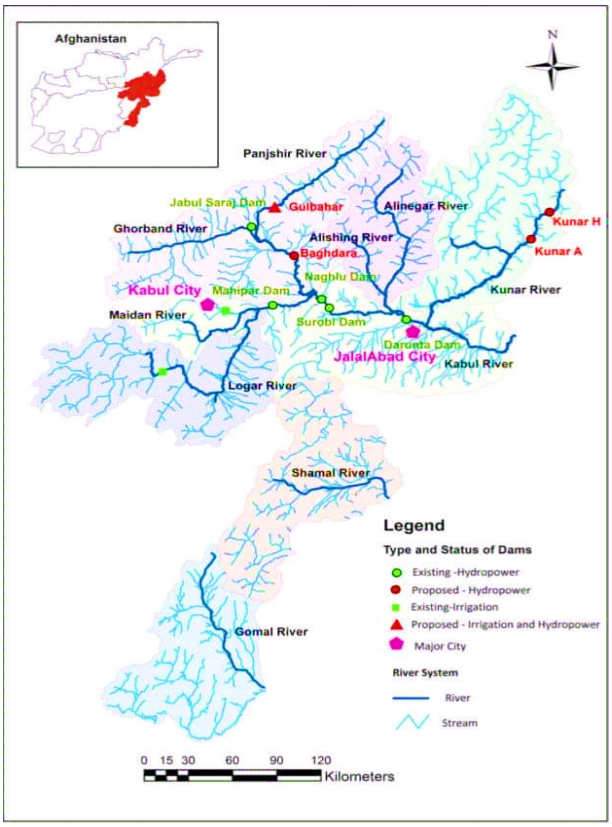

Figure 10. Map of main Rivers of Afghanistan.

Generally in Afghanistan we have five main river basins, it involves Kabul Indus River Basin, Helmand River Basin, Western River Basin, Northern River Basin and Northeastern River Basin (Figure11).

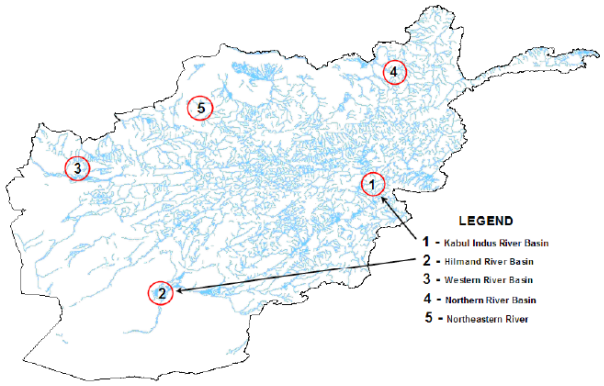

Figure 11. the main river basins of Afghanistan.

In Kabul Basin three main Rivers (Kabul, Paghman and Loger), its having different types of tributaries and joined together at the different point of drainage areas of every rivers. At the first areas flows very small runoff such as gully or rainrills and its join together making different kinds of streams (Figure 11).

The main rivers of the Kabul Sub-basins consist of Kabul, Paghman, Loger, Panjsher Ghurband rivers. From these only Ghurband and Panjsher rivers are flows at the all four seasons of year, but the Kabul, Loger and Paghman Rivers only flows at the precipitation and snowmelting seasons (Figure 12).

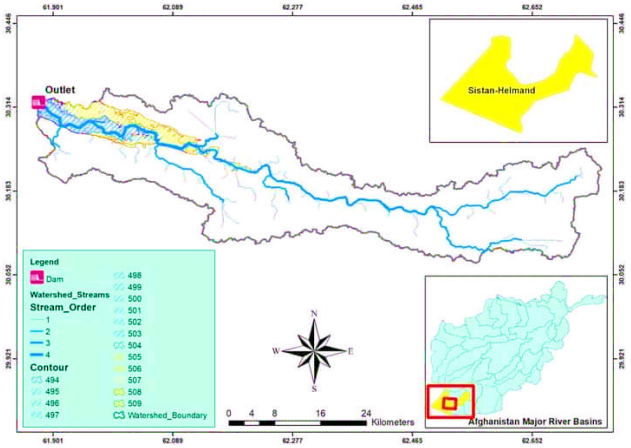

Figure 12. Panjsher River basin, belong to Kabul Sub-basins.

The average elevation at the sources are 5983 m a.s.l. which is consisting of Wardak and Paghman mountains ranges. These areas consist of skirts and slope areas (upper course), in these areas the velocity of rivers is very high and its only eroded the river bed (down cutting) and transported bigger sizes such as boulder, cobbles and pebbles. After passing some distance the velocity of river middle (middle course), which eroded lateral and bed, which carrying different sizes of gravels, sands, silts. At the end plains areas (lower course), which average height are 383 m a.s.l. and making different types of meanders, which transported different types of sizes such as silts and clay. At the high altitudes having more snow cover which is melting at the summer months (March to June) and Kabul river drained from the snow cover melting (Figure 13).

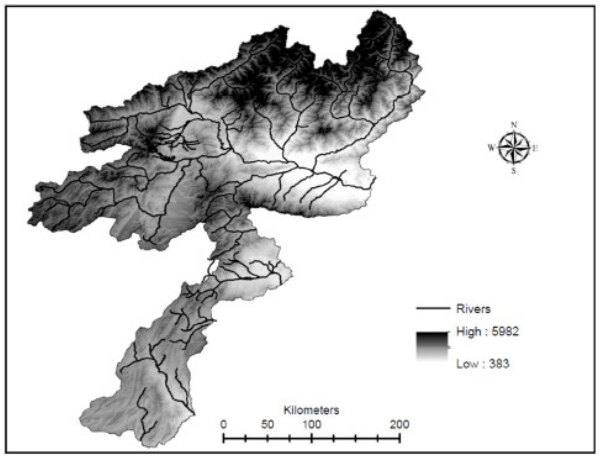

Figure 13. Elevation model of Kabul River Stream flows.

Kunar River is one of the main river of Afghanistan, which is flows at the four seasons of year. The drainage area of this river is very higher and it's sourced from glacier areas of Afghanistan. This River having different kinds of tributaries which is joined together at the different points of this basin. As well as by this river transporting different masses of sediments and making different types of layers, from these profiles, we can find the climate changes from previous geological periods (Figure 14).

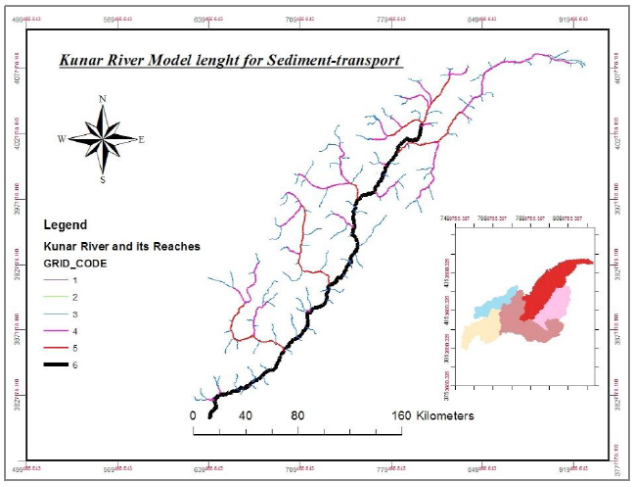

Figure 14. Kunar River basin with its tributaries.

Kabul river basin is also one of the bigger basin of Afghanistan, which is started from Jalreze district (Onay mountains, belongs to Wardak mountain ranges) in Wardak province. The drainage area of this river having different types of climate, at the source having cold climate

which is covered by snows, but at the down areas having rainfall in warm areas. This river at the different points join with Panjsher, Kunar and others tributaries (Figure 13).

The Kabul Sub-basins are different flows year to year due to clime change, because the volume of water belongs to leakage of precipitation, because the surface water are closely to the precipitation. The all volume of water in Kabal basin for 2020 described in Figure 15.

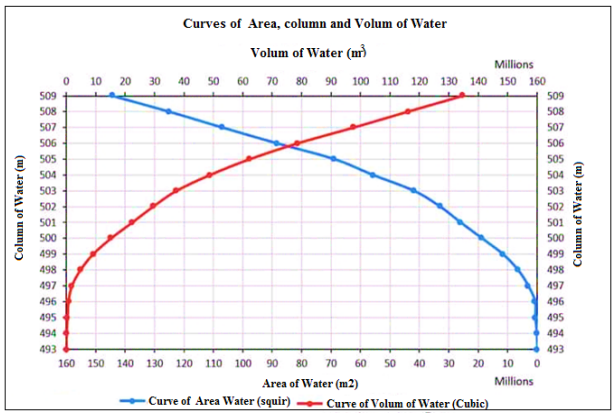

Figure 15. Curves of Area, column and Volume of water in Kabul sub-basins.

The mean annual discharge at Tange Gharu Hydrological station (1960-1980), if we look at the linear slope is from1960 to 1980. The Tange Gharu Hydrological station one of the main stations of Kabul Sub-basins, which is junction point of three main rivers (Kabul, Loger and Paghman), because more water of Kabul basin leaving from this point. In Kabul basin in addition river flows, here are some canals and waste waters flows also, that are coming from Kabul city (Figure 16).

Panjsher River is the main rivers of Afghanistan, which is flows from more than 7000 m a. s. l. from glacierized areas Hundu Kush mountains range in Afghanistan. This river flow at the all four seasons of year and there are no any drying for this river. Maximum, mean and minimum annually discharge from 1960 to 1980 from Panjsher River in Figure17.

The Tange Gharu Hydrological station is one of the very important station in Kabul basin, which is installed in the junction point of three rivers (Kabul, Loger and Paghman) at the Tange Gharu mountains region. In winter season having more discharge due to snowmelting in the Paghman mountain ranges. Annually mean discharge from 2006-2008 at the Tange Gharu Hydrological station show in Figure 18.

If looking at the Figure 13, the climate changes also effects on discharge of rivers in Kabul Sub-basins, the mean annually discharge from Kabul basins more than in 2007, but the lease than are for 2017 and we can see from linear, because the slope of line are from 2007 to 2017. From that we can find from 2007 to 2017 are leakage of precipitation due to climate change. The main reasons of these are air pollution and destroyed ozone layer in atmosphere (Figure 19).

The mean discharge from 2008 to 2017 increasing, the mean reason of these are the glacier melting due to climate change and increasing the air temperature from 2008 to 2017. Maximum, Mean and Minimum discharge from 2008 to 2017 from Panjsher River show in Figure 20.

The Sangi Nawshta Hydrological station is installed on Loger River belongs to Kabul province. If we appearance to the Figure 21 the more discharge of this river starts from April to August, but the higher peak of discharge of this river is in the June which is 172.65 m^3/sec. The dry months of year are September to March, because of absence of snow cover and rainfall.Monthly mean discharge from 2008 to 2017 Loger river at the Sangi Nawshta Hydrological station shown in Figure 21.

If we compare the last years (1960-1980) to 2008-2017 years, in the Sangi Nawshta Hydrological station is almost same to the 2008 to 2017. If we look to the Figure 22 the more discharge of river starts from April to August, but the higher peak of discharge of this river is in the June which is 219 m^3/sec. The dry months of year are September to March, because of absence of snow cover and rainfall. Monthly mean discharge from1960 to 1980 Loger river in Sangi Nawshta Hydrological station shown in Figure 22.

The temperature of Afghanistan is different according to the regions, generally in south parts, because of plane area warm, and at the east and west sides are depth location warm, but the north parts, because of high mountains are colder. The temperature of water is directly belonging to the temperature of region. Temperature of Panjsher, Ghurband and Panjsher Rivers for 2020 and it is comparing with the international standards shown in Figure 23.

The conductivity measurement principally belongs to amount of salt solution, and its shows the quantity of salt solved in water. At some time the electro-conductivity related to the water temperature that having at the period of measurement. EC of Panjsher, Ghurband and Panjsher Rivers for 2020 and comparing with international standards (Figure 24).

TDS (Total Dissolved Solid) belongs to the amount of solution and smaller particles those are solved in

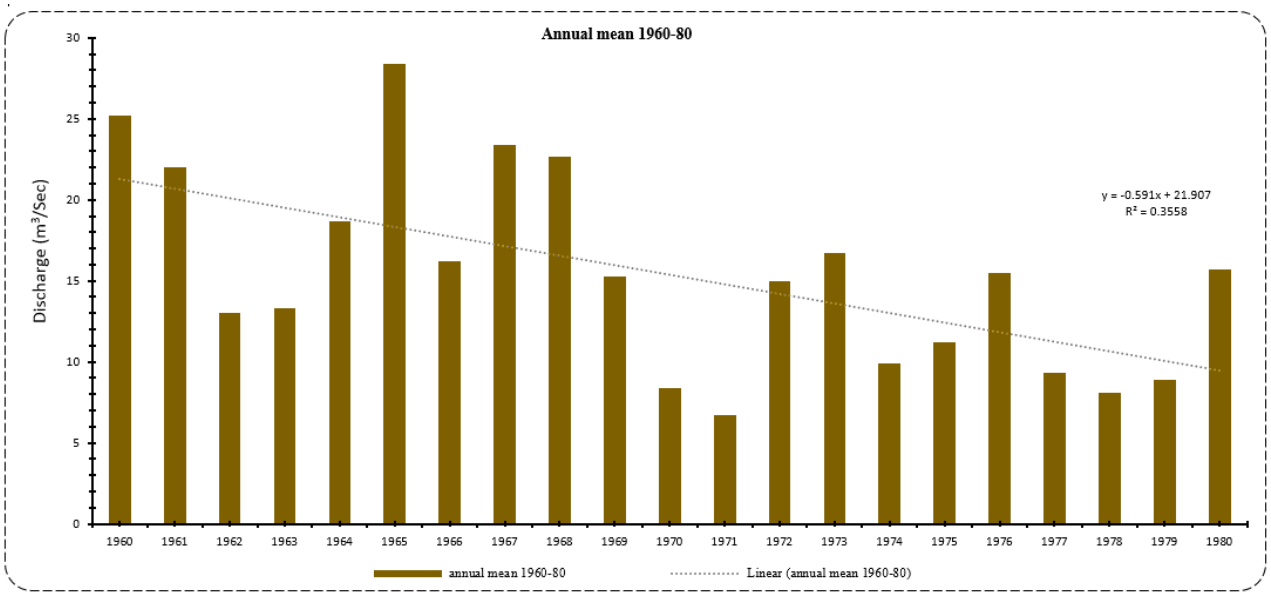

Figure 16. Annually mean discharge at the Tange Gharu Hydrological station (1960 -1980).

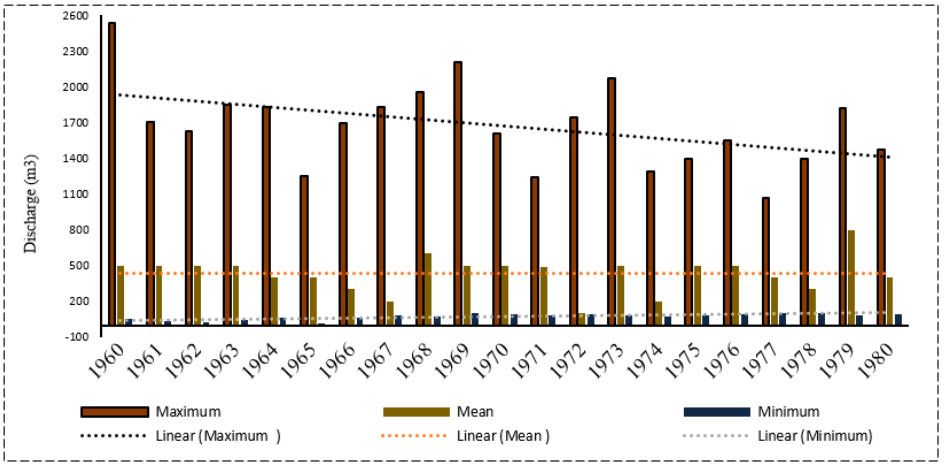

Figure 17. Maximum, mean and minimum annually discharge from 1960 to 1980 in Panjsher River.

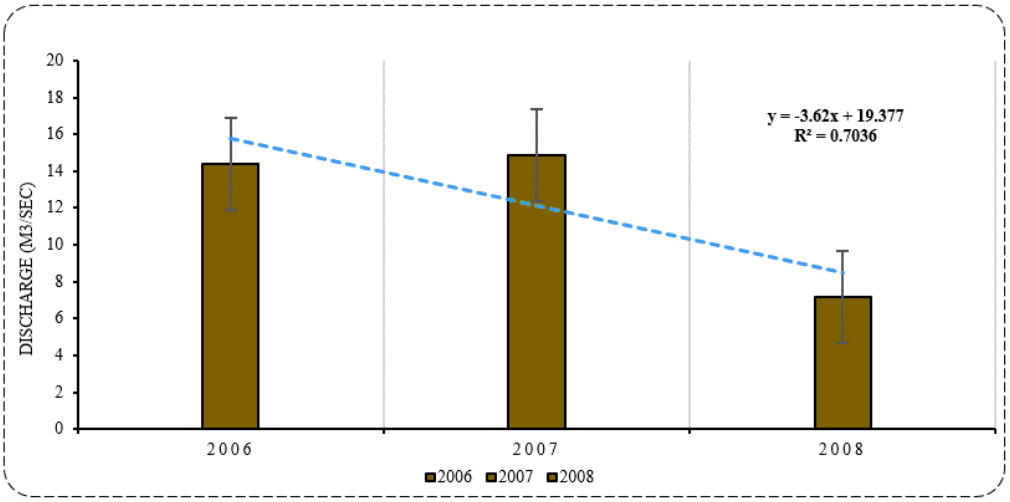

Figure 18. Annually mean discharge at the Tange Gharu Hydrological station (2006 - 2008).

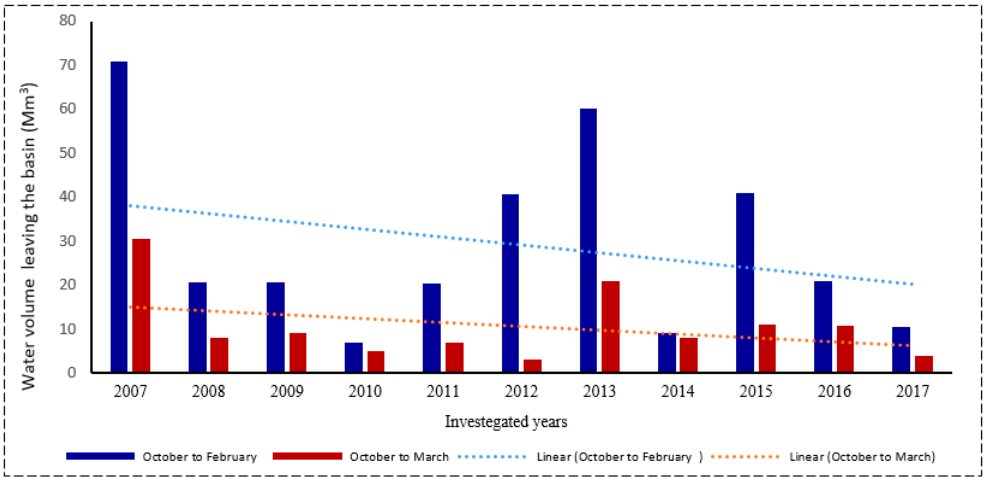

Figure 19. Volume of Water leaving central Kabul Sub- basin during October - February/March in Sangi Nawshta hydrological station.

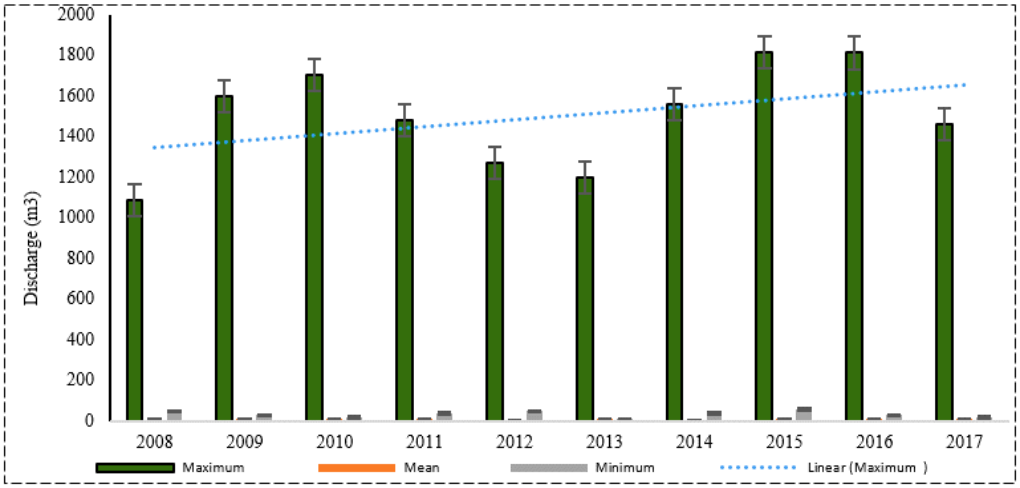

Figure 20. Maximum, Mean and Minimum discharge from 2008 to 2017 in Panjsher River.

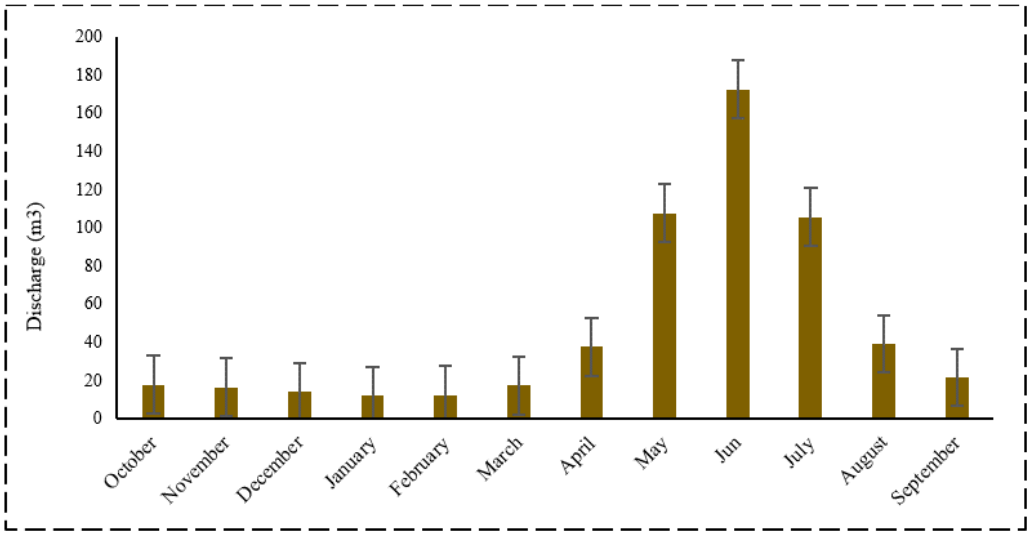

Figure 21. Monthly mean discharge from 2008 to 2017 Loger river at the Sangi Nawshta Hydrological station.

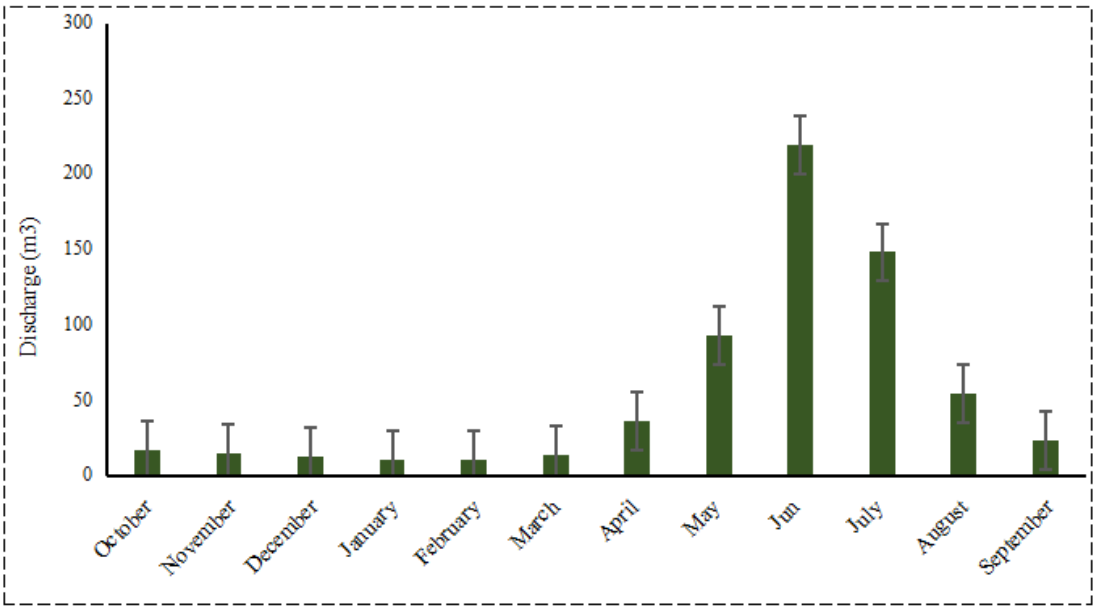

Figure 22. Monthly mean discharge from 1960 to 1980 Loger river in Sangi Nawshta Hydrological station.

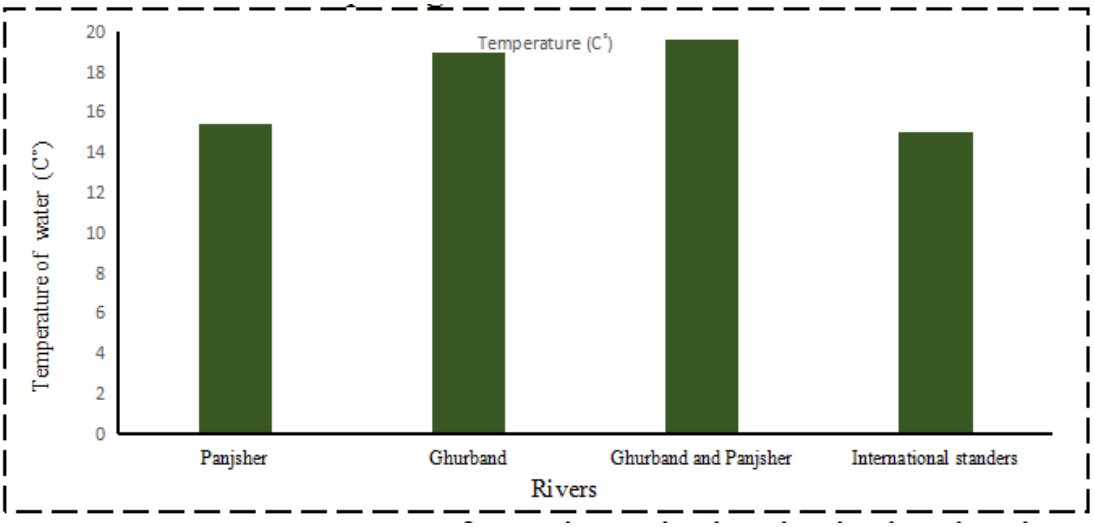

Figure 23. Temperature of Panjsher, Ghurband, Ghurband and Panjsher Rivers in 2020 and international standards for water.

water, which changes its color. In this research we used for measuring turbidity mater (mg.L^{-}). TDS of Panjsher, Ghurband and Panjsher Rivers in 2020 and comparing with international standards for water (Figure 25).

As for all clear, the O_2 is a part of water, which is composed in water (H_2O), two molecules Hydrogen (H_2), and one molecule oxygen (O_2). In this research DO of Panjsher, Ghurband and Panjsher Rivers for 2020 shown in Figure 26.

pH shows the range of acid and basic situations of river water, its ranged from 1 to 14. In these the 1-6.5 is acidic, in 7 is neutral and 7< is basic. In this research pH of Panjsher, Ghurband and Panjsher Rivers for 2020 and comparing with international standards for water shown in Figure 27.

3.3.2 Groundwater

The Groundwater resource of Kabul Sub-Basins belongs to the courses of surface water, that flows in relative basin rivers. From these water courses recharging to groundwater aquifers, mainly the aquifers are located at the banks and bed of rivers, and are mainly recharging at the snowmelting seasons, from rivers flows. As in Afghanistan we have three type of rivers, first one is flows at the four seasons of year from glaciers area (Hindu Kush mountains range) of Afghanistan, such as Helmand, Kuner

and Panjsher, the second one is flows only in snowmelting seasons and winter snow fall and rains such as Kabul, Loger, Paghman rivers, but the end and third one is belongs to sudden floods such as mountains valleys, that are occurs in summer seasons and recharging at the flow time to the groundwater (Figure 28). All groundwater in Afghanistan related to valleys, because we can find more thickness of sediments and making different types of aquifers.

In Afghanistan the groundwater sources because importance, that more populations using for drinking and irrigation waters. From the last years climate changes impacts on groundwater surface, and the air pollution directly effects on ground and surface waters quality and quantity. The groundwater surface fluctuations at in water seasons duration for one year, and due to snow cover snowmelting again recovery the groundwater surfaces from mountain areas snow cover and its drained from peaks of mountains at the duration year, but June to October the groundwater surface drawdown and making different types cone of derisions. The mean groundwater surface in Kabul province is about 30 m but in some places maybe 60 -70 m. The main reasons of drawdown are due to climate change in Afghanistan. Because from 1990 we not having any enough precipitation in Afghanistan, and the surface of groundwater came down (Figures 29). As we can see in the different graphs of hydro-meteorological data. Figure 30 shows the five rings of wells (Khair Khana area, Khair Khana, Shahrake Police, Taimani and Marorayan wells belong to Kabul province), that fluctuated at the different months from 2004 to 2017 years.

The monthly mean rate of recharging to groundwater, belongs to precipitation, surface water flows, but in the last years due to climate change the more groundwater recharge to the surface water by springs, these are located at the river beds. There are not balance between surface and groundwater, but divers some groundwater adds to the surface water, and at result the water level of groundwater drawdown. The monthly mean from 2007 to 2012, relationship between precipitation, discharge and recharge to the groundwater shown in Figure 30.

3.4 Air Pollution in Kabul Sub-basins and Afghanistan

The climate change also effects on the air pollution in Kabul province, as well as in all surrounding sub-basins of Afghanistan. Because the many years continues drought the mountains, deserts and even agricultural lands are bare and without any vegetation covers. Also in Kabul sub-basins we not having more rainfall from 1995, because these reasons the air is full from CO_2, CO, PM, NO_2, SO_2, O_3, CO, Pb, and another toxic gases. From these reasons, when occurs short time some rainfall, the air washing by acidic rains and after drying, because of lower density again fly toward atmosphere and at the duration one year, it done two or three completely cycles. These all the main reasons of air pollution in Kabul sub-basins, some reasons of climate change, described one by one such as, average time, the maximum limit concentration and the ways of Measurements, Standard Advice air quality for Afghanistan, National standards for Afghanistan air, Definition of Solid waste, effects of air pollution, greenhouse gases Spread in Afghanistan for 2005, and last five years drought result, describes as follows:

3.4.1 Parameters, Average Time, the Maximum Limit Concentration and the Ways of Measurements

More country of the world are having six standards of air quality are more pay attention to PM NO_2, SO_2, O_3, CO, and Pb. In fact, the development bank of Asia shows amount of PM10 in air of Afghanistan very higher.

3.4.2 Standards of Air Quality for Afghanistan

Also oil and wood stoves for warming houses and or by machine that are using for groundwater or in houses using diesel electricity and coal for bricks making and using for building, riels, airplane, machine and stove produced toxic gases, at the result reduced oxides nitrogen gases in air and all lives of animal and plants making with problems. Also, in the different wards garbage collected at the land surface or without any scientific buried under ground, at the result making different problems for air and ground waters [11,12].

3.4.3 Definition of Solid Waste

Solid waste are generated from households, offices, shops, markets, restaurants, public institutions, industrial installations, water works and sewage facilities, construction and demolition sites, and agricultural activities are all of call soled wast (Figure 31).

3.4.4 The Effects of Air Pollution

The air pollution effects on all living, and its living face with the problems. The air pollution effects on

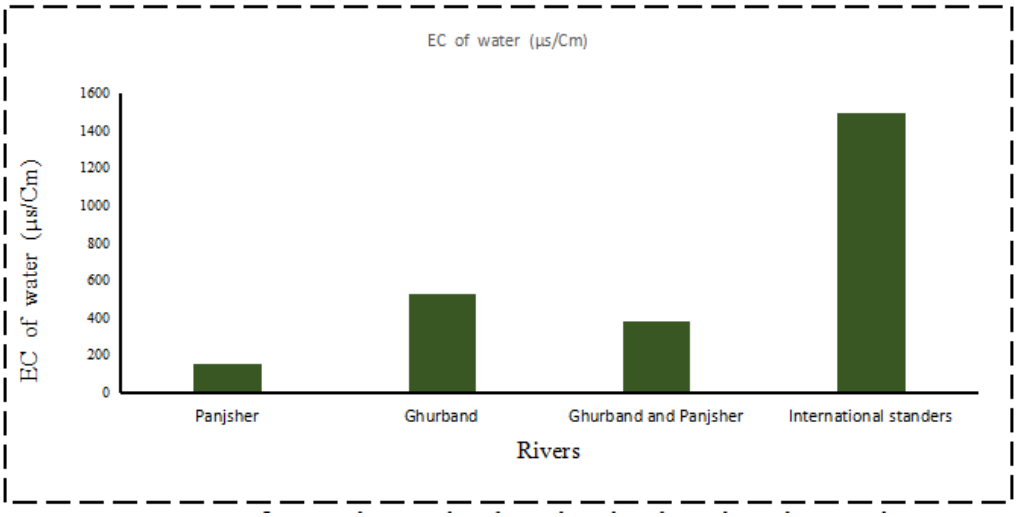

Figure 24. EC of Panjsher, Ghurband, Ghurband and Panjsher Rivers for 2020 and international standards for water.

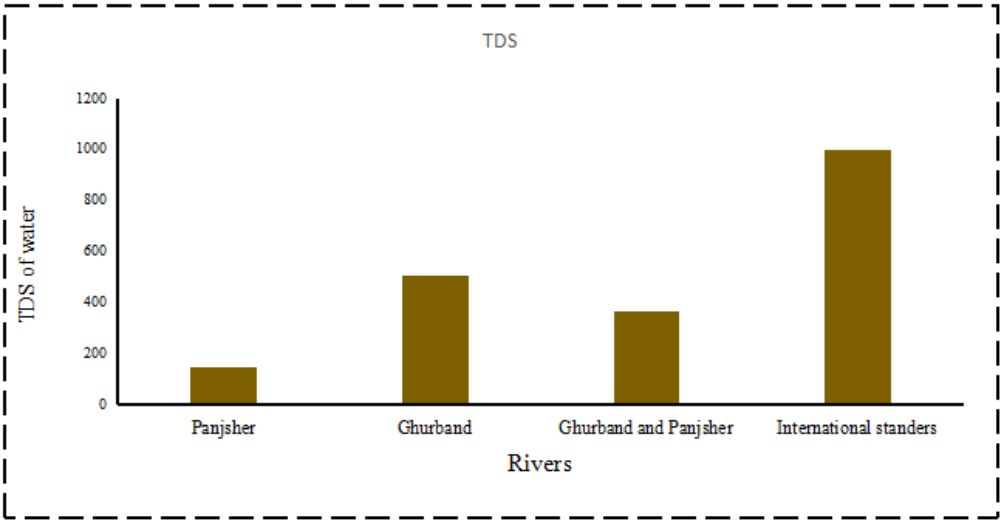

Figure 25. TDS of Panjsher, Ghurband, Ghurband and Panjsher Rivers in 2020 and international standards for water.

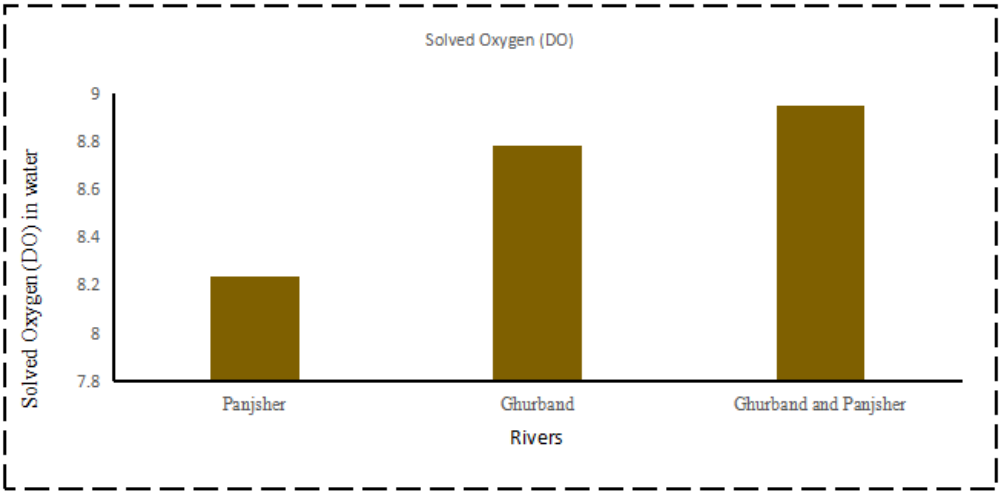

Figure 26. DO of Panjsher, Ghurband, Ghurband and Panjsher Rivers for 2020.

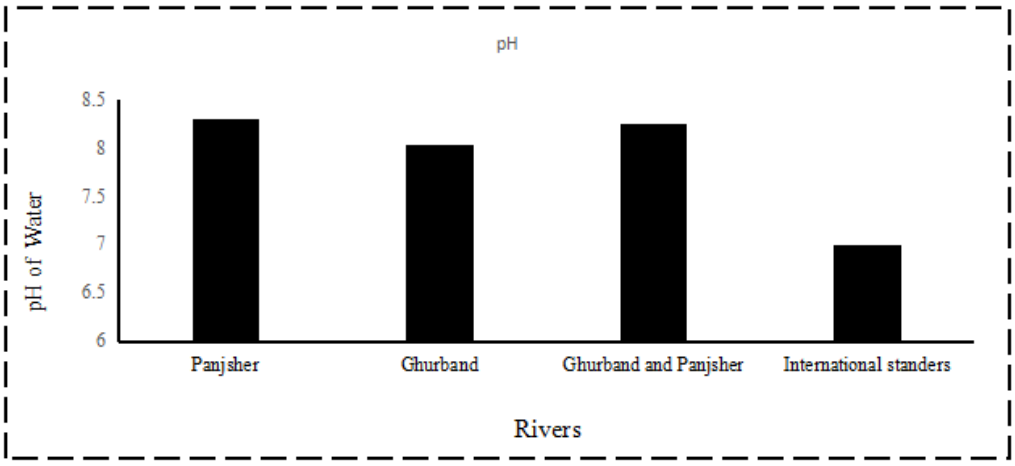

Figure 27. pH of Panjsher, Ghurband, Ghurband and Panjsher Rivers for 2020 and international standards for water.

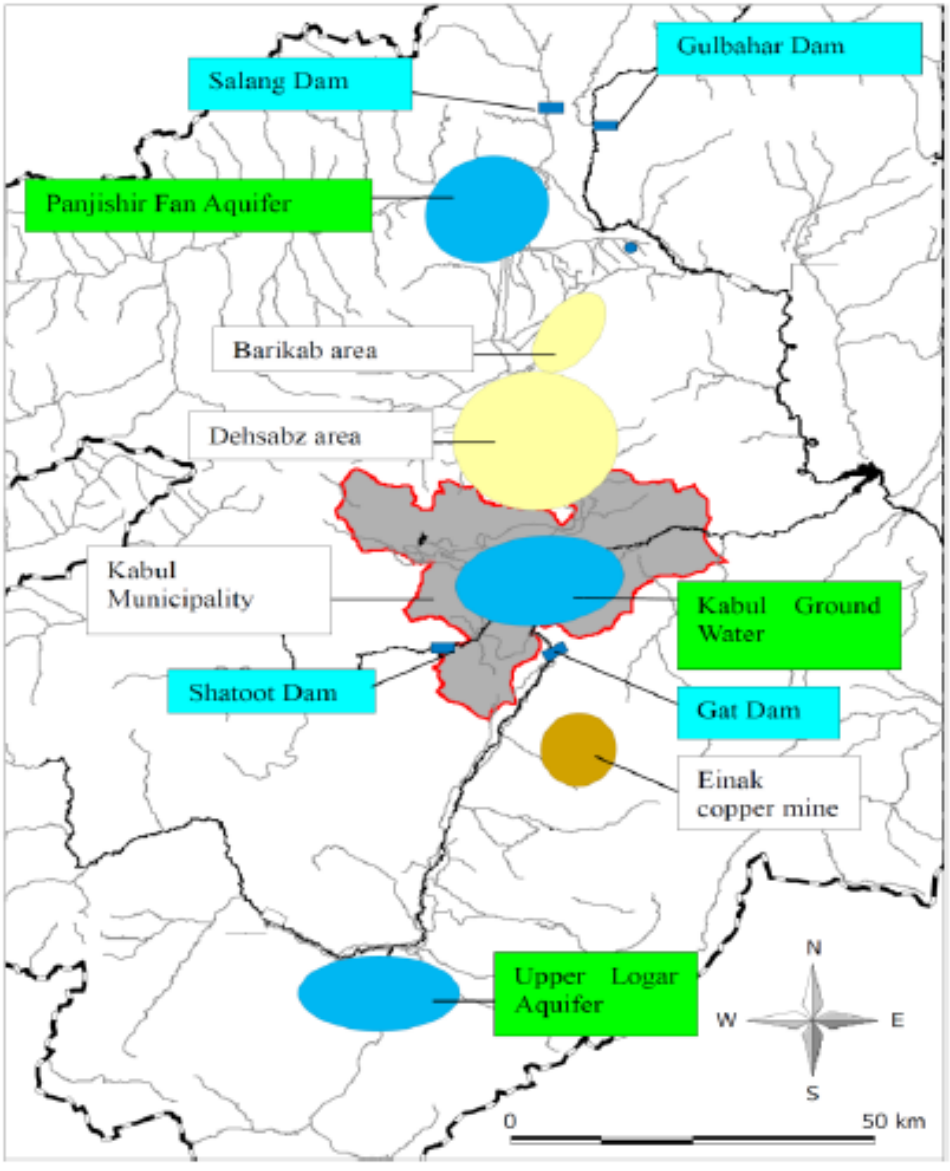

Figure 28. Groundwater map of Kabul Sub-basins.

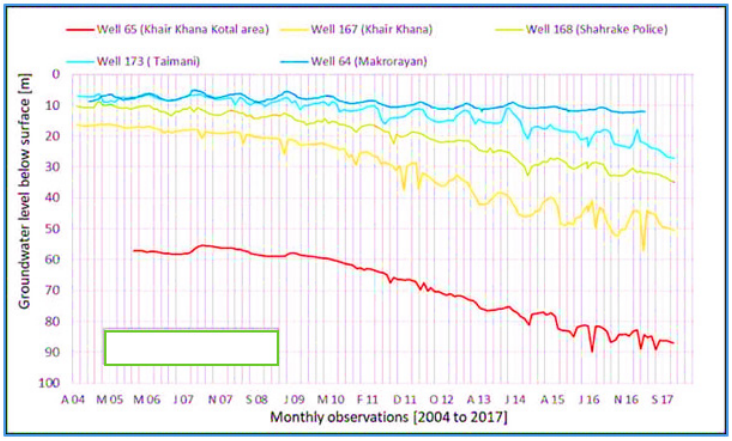

Figure 29. Monthly Groundwater water level in Kabul for 2005 to 2017.

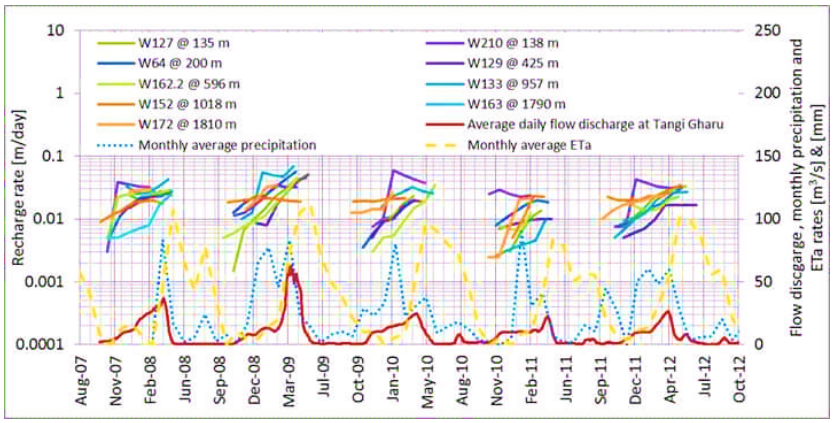

Figure 30. Monthly Groundwater recharge, surface water discharge and precipitation in Kabul for 2007 to 2012.

Table 1. National Standards for Afghanistan Air [14].

No	Parameter	Unit	Mean weight	Maximum concentration	Method of measurement
1	TSP (Total Suspended Particles)	µg/m^3	Annually	-	(average flow ≥ 1.1 m^3/min)
			24 hours	300	
			8 hours	-	
2	PM_{10} (suspended Particles smaller from 10 Micron diameter)	µg/m^3	Annually	70	(β- Ray Absorption) (Low volume sampler or β- Ray Absorption)
			24 hours	150	
			8 hours	-	
3	$PM_{2.5}$ (suspended Particles smaller from 2.5 Micron diameter)	µg/m^3	Annually	35	(β- Ray Absorption) (Low volume sampler or β- Ray Absorption)
			24 hours	75	
			8 hours	-	
4	Nitrogen Oxides (NO_2)	µg/m^3	Annually	40	Diffusion (Gas Phase Chemiluminescence)
			24 hours	80	
			1 hour	-	
5	Sulfur Di oxides (SO_2)	µg/m^3	Annually	-	Diffusion (Ultraviolet Fluorescence method)
			24 hours	50	
			1 hour	-	
6	Ozone (O_3)	µg/m^3	Annually	-	Non dispersive UV absorption
			24 hours	100	
			1 hour	-	
7	Carbone monoxide (CO)	µg/m^3	Annually	10	Non Dispersive Infra-Red (NDIR)
			24 hours	30	
			1 hour	60	
8	Lead (Pb)	µg/m^3	Annually	0.5	(ASS Method after using EPM 2000 or equivalent filter paper)
			24 hours	-	
			1 hour	-	

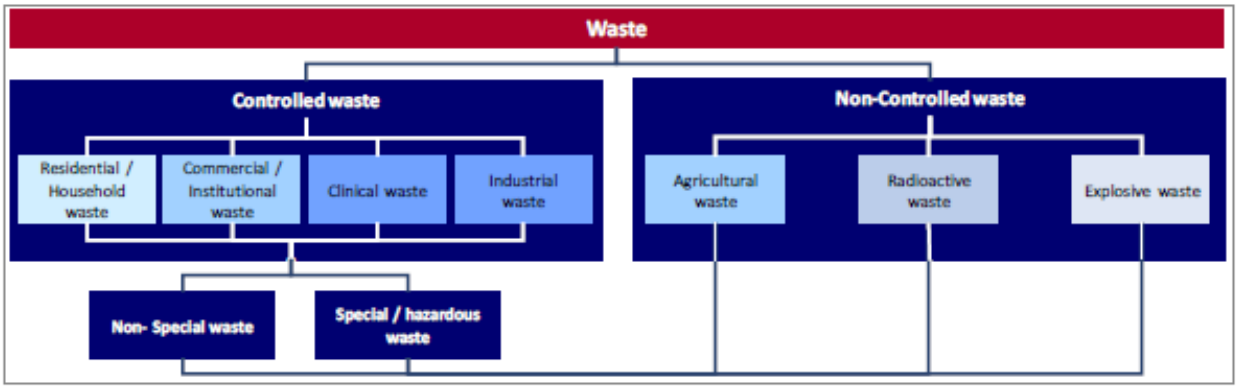

Figure 31. Solid waste is generated at the different type of industries in Kabul city.

living of all human, with different bad conditions like respiration, lung, cardiac, neurologic and others. The old peoples, women, children are all facing, and they are very sensitive. Different Research's clear that more peoples pace with different problems of lungs, it is from normal activities change to abnormal, and finding different problems. Also, the air pollutions effects on human life like eyes, skin, and some time it will be cancer.

From studies established that, in air pollution involves Carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO_2), Ozone (O_3), lead (Pb), and small particle (PM), vehicles slander, burned oil, wood burned, in factories coal burning, Petroleum and gases machines, sulfuric acids, sulfur gases, melting of iron, lead, and another metals melting in factories, vehicles diesel engine came out. Remarkable air dangerous material results are different problems like heat, skin, respiration, and weakness of body, lung problems, eyes problems, high pressure of blood and other tens problems making. As well as in addition these problems for human life and environment.

Table 2. Greenhouse Gases Spread in Afghanistan in 2005 [14].

No	Reservoirs	① Gg	Gg	Gg
1	National	19.200	80.487	32. 125
2	Energy	0.4188	33.016	04. 291
3	Industries energy	0.0034	0.0150	27. 500
4		0.0954	0.0545	32. 345
5	Product	0.0026	0.0104	41. 150
6	Transportation	0.0300	0.4900	20. 167
7	Trade fossils	0.0710	6.400	9. 930
8	House garbage	0.3100	26.07	05. 381
9	Agriculture	0.0018	0.031	21. 113
10	National	19.200	80.487	32. 125

From above table clear in 2005 greenhouse gases especially, Ozone spreading are very higher. These gases in the world main reason of air pollution and changing the climate, at the result more peoples making problem and killing. From 2006-2010 more people's problems of Malaria and more peoples killed. Unfortunately, in Afghanistan, we have more malaria conditions. From climatic first reported in 2003, 2.5-3 million we have malaria and those children smaller 5 years dysenteries and 8500 reported. The climate change result long term drought and the climate change more people's migrations. From some information at the last five years at the Afghanistan, we have four main droughts, it's clear in Table 3.

① Giga gram

Table 3. Last five years drought result [12].

No	Years	Duration
1	1963 – 1964	2 years
2	1970- 1972	3 years
3	1986 – 1987	2 years
4	2006 – 2007	1 year

From above table clear that, at the ancient year's drought was very short term, but at the last end year's drought was very long term and many ten years received. If we not thinking about the future drought will be another long time climatic effects.

4. Conclusions

The data analysis of hydrometeorological and groundwater are used to determine climate change, for Kabul sub-basins, in Afghanistan. The calculated mean annual maximum temperature at Kabul airport from 1958 to 2010 is 26.9 ˚C in 2003, the minimum is 2.41 ˚C in 1964 at the Sangi Nawshta meteorological station the maximum temperature is 38.1 ˚C in 2011 and minimum is -11˚C in 2012, but the monthly mean temperature in Parwan Meteorological Station province from 1958-2010 is in April, which is 26.9 ˚C. The annually rainfall from 1957-1983 in Omarzai meteorological station, higher rainfall is in 1959, which is 66 mm, and the minimum is

12.82 mm in 1977, from 2003-2010 in Sangi Nawshta Meteorological station annually mean maximum rainfall 32.09 mm in 2006, minimum is 14.67 mm in 2008, annually maximum and total annual precipitation from 2010 to 2017 in the Qalay Malik Station, maximum is 396 mm in 2010 and the minimum is 271 mm in 2013, monthly precipitation changes from 1958 -1983 and 2003-2010 in the Omarzai Station, maximum is 58.9 mm, in March and minimum is 2.23 mm in October. Surface water flowing belongs to precipitation, snowmelting seasons and sudden floods. From 1960-1980 annually mean discharge at the Tange Gharu Hydrological station in 1965 which is 28.4 m^3/sec, but the lower is 1971 which is 6.71 m^3/sec, and from 2006-2008 annually mean discharge at the Tange Gharu hydrological station, maximum is in 2006 which is 14.4 m^3/sec and minimum is in 2008 which is 7.16 m^3/sec. From 1960 to 1980 in Panjsher River, mean annually maximum discharge is in 1960, which is 2530 m^3/sec, and minimum is in 1977, which is 40 m^3/sec. Volume of Water leaving central Kabul sub-basin during 2007-2017, October-February/March in Sangi Nawshta hydrological station, maximum is in 2007, which is 70.8 Mm^3 and minimum is 3 Mm^3 in 2012. Maximum, Mean and Minimum discharge from 2008 to 2017 in Panjsher River, the maximum is 1814.4 m^3/sec in 2015, but the minimum is 8.54 m^3/sec in 2012.

The mean of these data shows good results for climate change, which effects on groundwater fluctuations, snow cover and glaciers volumes in Afghanistan. The groundwater water level in Kabul sub-basin decreased from 2005 to 2017, the mean groundwater level drawdown in 2005 is 60 m, but in 2017 is about 90 m depth from ground surface due to climate change.

The results obtained suggest that to avoid the factors, that effects on climate change, surface and groundwater. All national and international organizations suggest to done scientific research works about it. Otherwise in Afghanistan after some years will be face to the bigger problems of air pollutions and scarcity of surface and groundwater. As well as will be more agricultural lands and deserts will be face, with the drought problems and foods.

Acknowledgements

I extend my thanks to our faculty members who helped us put this paper together.

Table 4. Some Abbreviations and Formulas I used in this research.

ANSA	Afghan National Standards Authority
AS	Afghan Standard
CO	Carbon Monoxide
$\mu g/m^3$	Micrograms per cubic meter
NAAQSA	National Ambient Air Quality Standard for Afghanistan
NEPA	National Environmental Protection Agency
NO_2	Nitrogen dioxide
O_3	Ozone
PM	Particulate matter
PM_{10}	Particulate matter with a diameter of not more than 10 microns
$PM_{2.5}$	Particulate matter with a diameter of not more than 2.5 microns
SO_2	Sulfur dioxide
TSP	Total Suspended Particulates
WHO	World Health Organization

Conflicts of Interest

The author declares no conflicts of in interest regarding the publication of this paper.

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