AMBIENT AIR QUALITY ASSESSMENT AND RISK IMPACT DUE TO CLIMATE CHANGE IN KARACHI

Mohammad Idrees
02-282142-002

A thesis submitted in fulfillment of the

Requirements for the award of the degree of

Doctor of Philosophy (Environmental sciences)

Department of Earth and Environmental Sciences

BAHRIA UNIVERSITY KARACHI CAMPUS

September 2023

Approval for Examination

Scholar's Name: Mohammad Idrees

Registration No: 27188

Programme of Study: Environmental Sciences (Department: Earth and Environmental Sciences).

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DEDICATION

To my family, parents, and friends who encouraged me during this process.

ACKNOWLEDGEMENT

Firstly, I amgrateful to Almighty Allah who gave me proficiency, potency, valor and empowered me to accomplish the goal of completing my research.

I take the opportunity to express my gratitude and pious feelings to my supervisor for completion of this research work and entire phase of my studies.

At the end, I feel overwhelmed by the blessings, love and trust given by my parents and the endless support given by my family members.

ABSTRACT

2011-2020 was the warmest decade recorded, with global average temperature reaching 1.1°C above pre-industrial levels in 2019. Human-induced global warming is presently increasing at a rate of 0.2°C per decade. An increase of 2°C compared to the temperature in pre-industrial times is associated with serious negative impacts on to the natural environment and human health and wellbeing, including a much higher risk that dangerous and possibly catastrophic changes in the global environment will occur. For this reason, the international community has recognized the need to keep warming well below 2°C and pursue efforts to limit it to 1.5°C.

The excessive global emission of greenhouse gases (mainly carbon dioxide, CO_2 and methane, CH_4), especially due to the burning of fossil fuel for energy and power generation, is the main cause to the air pollution and greenhouse effect. This has eventually brought many issues, such as climate change and global warming that will affect the standard life of human beings. Many strategies have been proposed to further reduce the excessive emission of greenhouse gases, including CO_2 and CH_4 utilization. This method not only reduces the CO_2 concentration in the atmosphere, but also producing renewable energy (syngas) at the same time. Hence, CO_2 and CH_4 utilization is also a promising approach to assist in overcoming the energy crisis due to the increasing population in time. Basically, the utilization of CO_2 and CH_4 system can be categorized into four: (i) electrochemical reduction, (ii) advanced catalyst system, (iii) photo catalytic reduction, and (iv)Plasma technology. In this review paper, the mechanism implemented on the four abovementioned categories and their respective limitations are presented. Besides, a future recommendation to optimize the greenhouse gases utilization system for up-scaling purpose is also highlighted.

The entire world is now confronting the horrendous effects of environmental change. The environmental change, impacted by expanding arrival of harmful gases in the air, untreated modern squanders in the waters and least consideration about factors that add to environmental change. Nation's significant urban communities have air contamination among disturbing on the planet which is affecting the economy and human wellbeing. This study is assigned as the gamble appraisal of environmental change and subsequently its consequences for Karachi metropolitan. The study will talk about factors which are viewed as significant part of progress and hazard related with environmental change. The studies were planned based on occasional variety from four modern gatherings viz. Sindh Industrial Trading Estate (S.I.T.E) region, North Karachi modern region, Korangi modern region and Landhi modern region in the year 2017-2019. These assigned regions are likewise mix of modern, private, business and weighty traffic zones with thick populace. As an impetus Ambient air information was gathered for various contaminations like Nitrogen Oxides (NOx), Carbon Monoxide (CO), Sulfur Dioxide (SO2), and Particulate Matters making out of complete suspended particulate matter, particulate matter 10-micron size as well as particulate matter 2.5-micron size.

Perceptions have shown raised content of particulate matters in the conduct of pre-storm season, though CO and NO2 fixations found in every one of the four zones are calm in the air samples. Sindh Environmental Protection Agency (SEPA) guidelines, explicitly in Landhi, S.I.T.E Area and Korangi show more violations and deviations. Then again, in every one of the four modern zones through post-storm season, how much particulate matters CO and NO_2 fixation saw as less to direct than the grouping of pre-rainstorm season because of the occasional varieties and impacts.

Likewise studies shows that three significant zones i.e., Landhi, Korangi and S.I.T.E. modern regions are at high of having air pollution and PM presence. While the North Karachi region is essentially risk because of having modest number or size of ventures. Accordingly, compliance of guidelines with respect to air quality is better.

The initial vulnerability screening (IVS) and weakness evaluation (IVA) connected with dangers prone to consider and quantify ideal for the gamble appraisal system (RAF) i.e., heat waves/high temperatures, extreme/heavy precipitation

occasions, raised waves and ocean water levels. RAF is seeing chance and outcomes of happening new occurrence, which are decide through a subjective gamble evaluation (QRA). The probability i.e., nearly certain(L1) has the > 90% possibility happening, Likely (L2) has 60-90% possibilities happening, conceivable (L3) has a 40-60% of chances of happening, Unlikely (L4) has 10-30% possibilities happening, Rare (L5) has <10% of chances of happening in the recognized time span. The Risk Assessment Matrix (RAM) in view of likelihood and potential outcomes importance, i.e., C1 to C5, which are Low to outrageous results.

The concentrate additionally figures out the outcomes related with C4 and C5 meanings. A subsequent assessment of C4 and C5 or a more noteworthy than the C5 likelihood presence of a C3 importance would likewise lean to driving the phases of chance reviewed high or outrageous. Thusly, the gamble evaluated high or limits estimated "unsuitable" for the judgments of RAF.

It is suggested that a public key structure strategy and change technique to be picked supportable administration of environmental change and its effects expected by the metropolitan.

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LIST OF ABBREVATIONS

AAQS	Ambient air quality standards
ACS	American Cancer Society
BC	Black carbon
BMI	Body mass index
CA	Chromosomal aberration
CAPS	Concentrated ambient particles
CEPI	Comprehensive Environmental Pollution Index
CI	Confidence interval
CO	Carbon monoxide
CO_2	Carbon dioxide
COPD	Chronic obstructive pulmonary disease
DCM	Dichloromethane
DFI	DNA fragmentation index
DMSO	Dimethyl sulfide
DMTU	Dimethyl thiourea
DTT	Dithiothreitol
EBC	Exhaled breath condensate
EC	Elemental carbon
ECD	Electrochemical detection
EDTA	Ethyl enediaminetetraacetic acid
GEM	Gaseous elemental mercury
GFFS	Glass-fiber filters
GIS	Geographic information system
HAPS	Hazardous air pollutants
HEPA	High-efficiency particulate air
HG-P	Particulate mercury
MS	Mass spectrometry
MSATS	Mobile source air toxics
NAAQS	National Ambient Air Quality Standards
NAMP	National Air Quality Monitoring Program
NAPS	National Air Pollution Surveillance
NATA	National-Scale Air Toxics Assessment

NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NMHC	Non-methane hydrocarbons
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NOX	Nitrogen oxides
PCBS	Polychlorinated biphenyls
PCES	Polychromatic erythrocytes
PEC	Pulmonary endocrine cell
PM	Particulate matter
PM_{10}	Particulate matter with particles of aerodynamic diameter < 10 μm
PM_{15}	Particulate matter with particles of aerodynamic diameter < 15 μm
$PM_{2.5}$	Particulate matter with particles of aerodynamic diameter < 2.5 μm
PMNS	Poly morphonuclear leukocytes
PNC	Particle number concentration
POPS	Persistent organic pollutants
PUF	Polyurethane foam
SPM	Suspended particulate matter
TK	Thymidine kinase
TLC	Thin-layer chromatography
TNF	Tumor necrosis factor
TSP	Total suspended particles
UFP	Ultrafine particles
VOCS	Volatile organic compounds

Chapter 1

INTRODUCTION

1.1 Introduction

Climate is the collective word for long-term variations in temperature, precipitation, and storm activity. Extreme events are becoming more frequent due to modern climate change, which entails changes in long-term averages as well as greater volatility around them(D'amato & Cecchi, 2008). One of the biggest ecological and socioeconomic issues of the twenty-first century is climate change (Thomas Dietz, 2020). In large part due to human activity, Earth's climate is changing quicker now than it ever has in the history of contemporary civilization (D'amato & Cecchi, 2008).By the end of the nineteenth century, it was evident that changes in atmospheric greenhouse gas concentrations (GHGs) might alter the planetary climate (Dai et al., 2005)Human activities have increased the atmospheric concentration of GHGs such as CO_2, methane, nitrous oxides, and chlorofluorocarbons since the industrial revolution, especially starting in the middle of the 20th century. At the same time, however, the albedo, or reflectivity, of the earth's surface has decreased(Dai et al., 2005). Due to GHG emissions and changes in albedo, by 2017, Earth's average temperature had risen by 1°C, over preindustrial levels .("Renew Sustain Energy Rev.," 2017). Reaching the target of 1.5°C, which is recognized as an upper bound to avoid significant danger of harm to the economy, human health and well-being, and the Earth's ecosystems, will be exceedingly challenging. Limiting overall warming to less than 2°C will be challenging. As stated by the Intergovernmental Panel on

Climate Change (Dai et al., 2005). The overwhelming evidence of environmental change includes rising sea levels, retreating ice sheets, altered precipitation patterns, and an increase in global temperatures. According to the Inter-Governmental Panel on Climate Change (IPCC), the current rate of GHG emissions will likely cause average temperatures to rise by 0.2°C every ten years, reaching a 2°C, over pre-modern levels by 2050? According to current data, there will undoubtedly be faster change, which might have a huge and occasionally irreversible influence on not just people but also other species and ecological systems (Dash et al., 2007)

Environmental change can possibly fix endeavors concerning poverty record, particularly in more inclined regions. Being a worldwide peculiarities environmental change, but its belongings can fluctuate with pessimistic effects are more seriously felt by needy individuals and unfortunate nations. Less special nations and individuals are more presented to adverse consequences of environmental change as their vocation is more connected with normal assets and they don't have esteem expansion or innovation related businesses. Endeavors to decrease fossil fuel by product and GHG will work on human wellbeing and prosperity and make green positions.

Environmental change is a severe reality and need critical endeavors in the event that we are to keep away from an irremediable loudening of ozone harming substances (GHGs) and a worldwide temperature alteration at a possibly titanic expense for the countries and social orders. Specialists are of the assessment that to benefit open door we want to act and presently. Further each extended time of postponement diminish this breathing space, which in future will then, at that point, require outrageous harder activity to keep the planet habitat able. Monetary concerns are not a decent reason for delay as this is a choice of endurance. In more extensive range development in practical way must be accomplished, when everybody settles on the plan to handle environmental change.

Environmental change is an approaching danger confronting the mankind, as significant impacts on food supply, water assets and wellbeing of masses will be seen. The world is as of now confronting the ruinous effects of environmental change as climate limits, fatalities like tempests, floods, tornadoes, dry seasons and so on, which are ascending in numbers and gravity. As indicated by specialists on environmental change, World's environment has definitely changed on full scale scales since the time

the starting modern revolution. Environmental Change Panel of Inter-Governmental on (Dhamala et al., 2019) assessed normal worldwide temperature might be increment between 1.4 to 5.8 °C before the century's over. This inconspicuous increment values in temperatures assessments to significantly affect the worldwide water sources, ocean level, food creation, and other related processes on the environment.

Environmental change is generally used to characterize any legitimate change or genuinely significant contrast in either the normal condition of the environment components like precipitation, temperature, airstreams, or strain; or in its inconstancy, went on throughout a restricted time span (many years or longer). It tends to be expressed to as the drawn-out change in worldwide atmospheric conditions, associated particularly with expansions in temperature, precipitation, and tempest action.

This variability in environment frameworks is a probable worth of the nursery impact by ozone depleting substances (GHGs). Instances of ozone depleting substances incorporate carbon dioxide (CO_2), methane (CH_4), di-nitrogen monoxide or nitrous oxide (N_2O), halocarbon gases, for example, tri-chlorofluorocarbon ($CFCl_3$) and di-chlorofluorocarbon (CF_2Cl_2), water (H_2O), per-fluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The barometrical groupings of these gases have been expanding, because of anthropogenic exercises.

Environmental change is credited straightforwardly or in a roundabout way to anthropogenic exercises that influence the normal arrangement of the worldwide environment components. It might likewise be an aftereffect of regular outside compelling, like changes in Earth's orbital factors, or sun powered outflow, and other normal inside cycles of the Earth's environment framework. The general impacts of outer anthropogenic and regular variables on environment can be extensively looked at, utilizing the idea of radioactive constraining. Radioactive constraining just alludes to the cycle that disturbs the infrared radiation balance between approaching sunlight based radiation from the Sun and the active radiation from the Earth. A positive release constraining principally brings about the overall warming of the Earth's surface and is because of expanding levels of GHGs.

Climate change and air quality are threats for the present and future. Studies and reports suggests that if immediate action are not taken air quality will worsen and can be a source of major casualties worldwide (Dilshad et al., 2010).Air quality in Asian countries is already far beyond acceptable limits for human consumption. Air quality and climate change are related, including emissions and atmospheric properties. In most cases, the same sources emit greenhouse gases and air pollutants. Vehicle emissions include particulate matter, NOx, CO,and CO_2. Further studies have shown that when particulate matter enters the atmosphere, it affects it by scattering and absorbing incident radiation, and for some time acts as condensation nuclei for clouds.

Changes in orbital factors, sun based result, or dangerous volcanic movement, are regular outer elements that can likewise cause emission. The precise record of these environment driving specialists and their disparities over a timescale is expected to comprehend past environment changes with regards to regular varieties, and to foresee the idea of future environment changes (Enrighta et al., 2005). The impacts of environmental change remember varieties for biosphere surrounding temperature, which could prompt hotness stress, change in precipitation designs, ocean level ascent, saltwater interruption, loss of biodiversity, dry season, living space misfortune, and freshwater consumption and contamination.

1.2 Defining Weather and Climate

The state of the air at a certain moment and location is referred to as the weather. Climate essentials include things like temperature, cloud kind, stickiness, precipitation, and winds. Storms, tornadoes, and rainstorms are crucial for a location's climate during specific seasons.

1.1.1 Climate Variability and Climate Change

Environmental change refers to variations in the state of the environment at all temporal and spatial scales outside of specific climate events. Change may result from variations in natural or anthropogenic (caused by humans) outside forces or from recurring inner cycles within the environment framework. Global environmental change refers to a shift in the environment's regular state or its volatility that lasts for at least a significant amount of time(ESCAP, 2015). Studies and scientific community singly and unarguably understands that human activities are causing climate change through emission of GHG. This takes into account adjustments to Earth's typical weather patterns, such as a shift in the average global temperature, as well as adjustments to the frequency of heat waves, dry spells, floods, storms, and other extreme weather events. It is important to remember that changes in specific climate events may have a significant impact on changes in environmental fluctuation. Industrious anthropogenic constraints, such as the expansion of ozone-depleting substances, Sulphate vapor sprayers, dark carbon to the climate, or land-use change, can cause environmental change to occur naturally as a result of an adjustment of the sun's energy or Earth's orbital cycle (regular environment compelling).

1.1.2 Climate System

Environment is a dynamic and intuitive framework. It comprises of the environment, land surface, snow, seas and other water bodies, and living creatures. Among these, the main part, air alludes to environment (Fam et al., 2017).

Different outside factors impact the interior elements of the Climate in entirety, and these incorporate normal peculiarities like volcanic ejections and sun

based radiations, as well as human-incited changes in barometrical orchestra. The whole environment framework gets the power and energy from the Sun. The radiation equilibrium of the earth might get altered by three essential ways (Farhan & Lim, 2012):

1) By changing the approaching sun powered radiation;

2) By changing the small amount of sun based radiation that is reflected (called "albedo"); also,

3) By modifying the long wave radiation from earth back towards space, environment thusly, answers straightforwardly to such changes, as well as by implication, through an assortment of criticism components.

1.1.3 Why "A Worldwide Temperature Alteration" is the Wrong Term

A dangerous atmospheric deviation (as well as worldwide cooling) is varieties in the surface temperature universally. A dangerous atmospheric deviation doesn't imply that temperature of the globe will rise similarly for the entire world. An expansion in temperature of the world will influence worldwide air course framework, causing lopsided temperature climb or lessening in various regions of the planet. A few regions could in fact get cooler. The phrase "a worldwide temperature fluctuation" is still often used by journalists and others to convey environmental change, despite the fact that it fundamentally distorts what really transpires (Fazal & Hotez, 2020). More environmental change is occurring than a warming trend (which is the reason the expression "a worldwide temperature alteration" is an incorrect depiction of the peculiarity).

1.1.4 Greenhouse Effect

A system called nursery impact controls the Earth's temperature so that it never becomes too cold or too hot. Our atmosphere traps the heat of the Sun near to the earth's surface, much like glass in a nursery does. This is primarily due to the heat-catching abilities of some "ozone damaging chemicals." Daylight warms the planet. The majority of the Sun's energy is transferred through the atmosphere, warming the planet's surface, oceans, and climate. The warming earth also radiates heat energy back into space as infrared radiation to maintain the equilibrium of the environment's energy budget. Mists and atoms of things that deplete the ozone layer in the lower environment ingest the most as this energy transmits vertically.

These radiate the energy in all directions, some vertically and some horizontally, so that it can be reabsorbed by various atoms located higher up. This cycle of intake and re-emanation is repeated until the energy finally escapes into space from the surrounding atmosphere. However, because a large portion of the energy has been recycled downward, surface temperatures are much higher than they would be if ozone-depleting compounds were not present in the air. The nursery impact is the term for this regular cycle. Without ozone-damaging chemicals, the average temperature on Earth would be 33 degrees colder 19 instead of 14C(Folland et al., 2001).The amount of ozone depleting compounds in our atmosphere has largely remained constant in recent years. Then, at that moment, years and years earlier, their obsessions began to grow as a result of altering land use and human settlement patterns, as well as the increasing demand for energy brought on by industrialization and population growth.

1.1.5 Greenhouse Gases

The ozone harming substances and their sources are as per the following:

- Water fumes are the most widely recognized ozone depleting substance anyway others are vital as well. Some happen normally and some come from human action.
- Carbon dioxide or CO_2 is a critical polluter ozone harming substance delivered by human exercises, for the most part through the consuming of non-renewable energy sources. It is the fundamental supporter of environmental change.
- Methane is delivered when regular vegetation is scorched, processed or decayed with no oxygen present. Trash dumps, rice paddies, and eating cows and other domesticated animals discharge heaps of methane(Frieden, 2010)
- Nitrous oxide can be found normally in the climate yet human exercises are expanding the sums.
- Nitrous oxide is delivered when compound composts. Nitrous oxide is delivered when compound composts and excrement are utilized in agribusiness.
- Halocarbons are a group of synthetics that incorporate CFCs (which additionally harm the ozone layer), and other human-caused synthetic compounds that to contain chlorine and fluorine.

Environmental change has been utilized reciprocally utilized with a worldwide temperature alteration, and the nursery impact. In any case, as of late they are being recognized separately, environmental change depicts any change or changes in current environment frameworks, whether because of normal fluctuation or due to human-based action, remembering a vertical pattern for normal temperature of the Earth's climate and seas throughout some stretch of time, known as a dangerous atmospheric deviation. The United Nations Framework Convention on Climate Change (UNFCCC)(Gadiwala & Burke, 2019) has taken on expression environment fluctuation for non-human interceded changes in environment components. Environment changeability is normally normal in beginning, coming about essentially from slight varieties in the complicated cycles that drive the development of hotness and mass between the air, the marine sea-going biological systems, and the land surfaces. For instance, the El Nino-Southern Oscillation (ENSO) is brought about by debilitating exchange winds the southern piece of the Pacific Ocean, and has reliably

impacted local varieties of precipitation and temperature over a significant part of the jungles, subtropics, and some mid-scope regions, prompting hotter episodes there. Exchange winds convey hotter air west,(Gadiwala & Sadiq, 2008) which prompts climbing ocean temperatures and expanded precipitation.

As indicated reports thru Intergovernmental Panel on Climate Change (IPCC), individuals are modifying the Earth's normal environment framework. Proof demonstrates that human-instigated environmental change, whenever permitted to proceed unabated, could have significant ramifications for the economy and the personal satisfaction of people in the future. Non-renewable energy source utilization, which has been consistently expanding since the pre-modern time frame, is causing a general expansion in groupings of air GHGs, particularly CO_2.

Flow research demonstrates that radiate compelling driven by ozone depleting substances is the essential driver of an unnatural weather change. As per these investigations, GHGs catches the Sun's hotness energy and forces a reallocation of the caught radiation accessible close to the world's surface, in this way controlling the Earth's temperature. GHGs, with accentuation on CO_2, are the fundamental non-environment factors driving environmental change. The persistent development of these gases is relied upon to cause critical changes in climatic circumstance over the course of the following century (Ghumman & Horney, 2016).

Different worldwide environment models are projecting huge environment change. Important influences can be felt on water assets, which will ultimately influence food assets, populace wellbeing, modern exercises, generally speaking transportation, and financial maintainability. Environment related Problems are for the most part should be visible in beach front regions and regions neighboring stream deltas which are beneath the waterway contour(Gornall et al., 2010).

People are generally stressed over the expansion in ozone harming substances in the worldwide climate because of its consecutive effect on the areas including floods, tempests, and dry seasons as well as a rising ocean level. Beach front regions have generally been inclined to changes in the rainstorm, the El Nino Southern Oscillations, and typhoons (Govan, 2017). Huge geological fragments are dry reach to semi-dry with significant spatial and fleeting contrasts climatic boundaries. For the

most part yearly precipitation is because of storm drains; a significant hydro-meteorological source ar for Pakistan(Grace et al., 2017). More prominent Himalayan district above 35o north in winter have downpour for the most part in type of snow and ice. The dissolving of snow gives waterways stream across the year. On the converse, seaside environment is confined to a flimsy strip neighboring the Arabian Sea going from South and Southeast. Seaside areas of Pakistan, with 1,046 km stretch of region (Gregory et al., 2005). On the east side, India has a typical line of 2,912 km while on the Westside Pakistan has a 909 Km long normal line(Guariglia et al., 2006).

Chronicled records show that outrageous fatalities like dry season and flooding on nearby framework, critical economically, social, and natural results. Hence, there is a need to underline the moderating effects of such huge effects. The beach front areas of Pakistan are as of now going through rising ocean levels (Gul et al., 2019)and expected to increment on the off chance that the latest thing proceeds. Pakistan is likewise remembered for tropical regions having high these specific impacts as estimated (Gulick, 1963)

To forestall intense environmental change impacts, Greenhouse gas outflows should have been decreased by 70% by 2050 (Gurjar et al., 2008). Specialists and government authorities are of the view that Pakistan is among the inclined conditions of environmental change yet just contributes 0.8% of absolute GHG emanations (Hanif, 2017).

Notwithstanding, we really want to act radically in our strategies on pressing reason for transformation, on the off chance that Pakistan's outflow couldn't be relieved or decreased (Harvey et al., 2005).

Air quality is one of the emerging environmental risks, with destroying and notable effect and financial impact on society. Huge augmentation has happened in the designs outpouring bases of air poisons in the democratic public (Hasan, 2015). Absurd trade improvements and vehicle usage amazing addition in view of huge people, in are contravention plain normal effect in the general(Hasan, 2016). The overall air contamination has proceeded as a significant danger in the natural wellbeing and personal satisfaction, explicitly in South Asia, while outflow regulator

apparatuses are not consistently being acknowledged (Hasan et al., 2013). Pakistan extends from the Arabian Sea in the south to the sloping area of the Himalayas in the North. The nation comprises and projections of future environment utilizing models of the environment framework.

When evidence of former glaciations led to the assertion that the world's current situation was inconsistent and had changed completely over a long period of time, the nineteenth century saw the emergence of the basis for the modern cohesive point of view on natural change. Confirmation of typical natural change paved the way for the possibility that people might also alter the climate. Svante Arrhenius, a researcher, hypothesized in 1896 that carbon dioxide emissions from humans would energies the typical nursery sway and so increase global temperatures. However, compared to the rise of environmentalism, the possibility of manmade ecological change did not begin to receive rational energy until the 1960s and 1970s. An increase in Earth's temperature became the accepted scientific theory in the 1980s. The establishment of the Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organization and the United Nations Environment Program in 1988 marked a significant advancement. The IPCC collects and assesses scientific, technical, and financial information that has been produced globally and is relevant to understanding environmental change. It does not conduct its own examination or verification; assuming all other factors are equal, it generates synopses or Assessment Reports. Five such Assessment Reports have so far been distributed, in the years 1990, 1995, 2001, 2007, and 2013–2014(Helsel & Hirsch, 1992).Typically, a report has four volumes. The first three volumes are focused on the actual scientific cause of environmental change, its impacts, transformation, and weakening, and how to moderate it. A report on amalgamations is the fourth item. Many scientists from all over the world consciously give their time to the growth of the IPCC reports as authors or analysts. The 195 states that are members of the IPCC contribute to the cycle of surveys and accept the IPCC reports. The reports are a reliable source of rational information about environmental change.

According to the Fifth Assessment Report, there is no doubt that the climate is warming. The air and sea have warmed, snow and ice have melted, the ocean level has risen, and ozone depleting chemical concentrations have increased (Hashmi et al.,

2005).

The report notes that the increase in atmospheric carbon dioxide is the main driver of observed warming and that it is "highly reasonable" that human activity has been the primary cause of this warming since the mid-20th century(Hashmi & Khani, 2003).

These alterations, as well as anticipated future changes, pose risks to typical human structures that, if unchecked, might have catastrophic effects. Risks to remarkable environments and societies, increased frequency of extreme weather events, unbalanced effects on impeded networks, global total effects on biodiversity and the economy, and the chance of large-scale specific events, such as ice sheet misfortune, are some of the main causes of concern (Hopke et al., 2008)

Change and lightning are the two types of responses to the threat that climate scientists detect. Variety is a strategy for adapting to natural change in which people take steps to mitigate or avoid bad effects and take advantage of important openings. This can involve switching to crops that fluctuate with the weather or constructing seawalls along the shore to protect against sea level rise. The other decision is balance, or abatement in human releases of ozone hurting substances to decrease the level of ecological change. Human ozone exhausting substance radiations come essentially from start of oil based commodities, deforestation, and provincial practices. Alleviation suggests superseding oil based goods with economical or low-surge decisions, shielding and laying out forests, and moving green practices. The test is that costs are caused in moving from the current techno-financial system to low-or zero-radiation decisions.

The coherent arrangement presented in the IPCC reports isn't uncontroversial. Though more than 97% of buddy overviewed articles that express a view on natural change support the arrangement that individuals are causing an Earth-wide temperature help (Hussain et al., 2010) a minuscule number of specialists and significantly greater number of non-scientists can't resist the urge to go against this understanding. Some argue that the Earth isn't warming in any capacity. Others recognize that the Earth is warming yet battle that the causes are fantastically ordinary. A third assembling recognizes the view that individuals are causing ecological change yet fights that the risks of natural change are immaterial or even

certain. Clearly, these various positions have altogether different ramifications for strategy and activity. The outcome has been a boisterous discussion about whether and how to answer environmental change. For sociologists, the rise of these various positions is of interest and brings up issues about the connection point among science and society (Hussain et al., 2012). The IPCC unequivocally endeavors to introduce discoveries that are strategy important and strategy unbiased, not approach prescriptive. However social orders have up until this point decided not to make a move on environmental change that is corresponding to the level of danger introduced by the IPCC. Without a doubt, environment researchers have been blamed for creating results and taking an interest in an intrigue to get continuous exploration subsidizing.

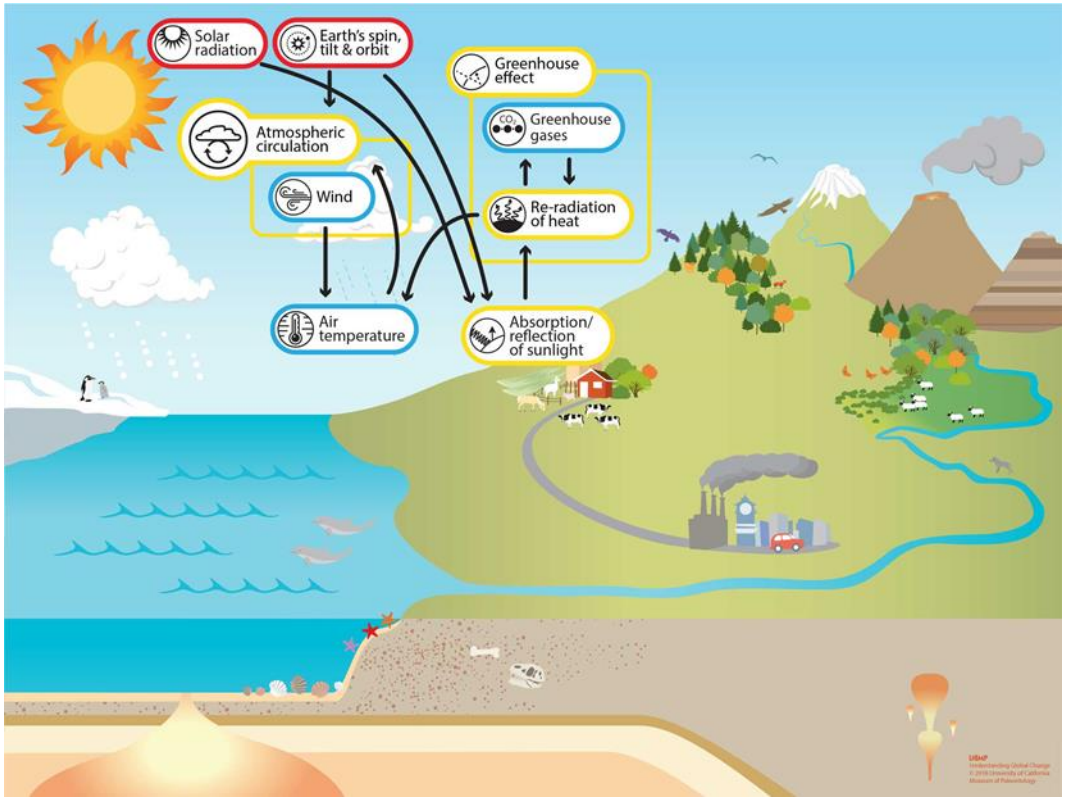

Figure 1.1. www.understandingglobalchange.org © 2018 UCMP

These social responses to the orderly structure indicate a shifting relationship between science and society. Sheila Jasanoff, a social analyst, challenges the idea that data is co-made and that our knowledge of and interactions with the environment are

unrelated to the ways in which people choose to live in it (Idress et al., 2021). Since all data is socially introduced, it follows that the IPCC's efforts to detach its intelligence evaluation from technique development are misguided. The IPCC cycle isolates facts from meaning and that the climate science framework disregards the typical request of objects of shrewd instinct. Natural change envelops the public movement of our organizations while temporarily and physically separating it from our lived experience. Natural change could be understood by applying cogent models, forecasts, and probabilities that are attempting to communicate with our regular, everyday presences. Reintegrating coherent climate representations with social responses to those representations is a major area of work for the human sciences, according to Jasanoff.

1.2 Aspects Influencing Impacts on Climate of Karachi's Coastal Regions

Pakistan's ability to acclimate to any conceivable climatic change situations in metropolitan is exceptionally low. As the metropolitan keeps on being Pakistan's business center point, social and monetary disparity is developing, and the climate is weakening. The framework of primate settlements, for example, favelas and raised landscape settle down are likewise in danger of flooding, water, and sloping glimmer floods in the non-appearance of satisfactory security and crisis answer structures. Touchy state locales and networks, towns are defenseless against flowing flooding(Ilyas et al., 2019)

Tropical cyclones are frequently coming to Badin resulting in flooding and torrential rain, making life of resident more difficult. Notwithstanding, the 1999 typhoon truly impacted the twins areas of Badin (Iqbal, 2020), Thatta and Sajawal, which were influencing populace of more than 0.6 million individuals and north of 200 people were dead. During the 2007 a twister Yammin were additionally hit the region and broadly affected in term of economy(Inam et al., 2022).

Mainland air: is principally dry and wins when there is no precipitation in region. In addition, changes in air sea conditions in faraway areas additionally influences on

environment of metropolitan, especially during the storm. In past climate information of Karachi is shows that it is no adjustment of normal precipitation (Inam et al., 2022)

Except for the edge on the Malir River, around no flood assurance and sewerage networks remembered for any water path. No extra room for floods water neither Malir River nor Layari River. On the off chance that we see what is happening of the center dam a logical dry spell circumstance, which is a significant flood repository safeguarded the metropolitan infrastructure during weighty downpours in Hub River shed and serving more than 5,000,000 populace of metropolitan. The livelihoods of significant human settlements situated in the country ghettos of Karachi rely upon farming, which depends basically on groundwater. Groundwater levels are as of now declining which is shift on rise angle and springs are in peril by humanoid activities, for example, sand mining(Irfan et al., 2018).

The other significant gamble region is absence of energy creation, supply and straight misfortunes. The utilization of energy is expanded because of many factors, for example, expansion in immigration, new modern foundation because of the great populace thickness, expanded gridlock therefor heat impact is possible high. In this setting of likely ocean level ascent, adverse consequences on wetland and intertidal biodiversity expected as well as possible loss of plants and creatures. Mangroves that might have filled in as a support against flowing floods previously annihilated.

Improper land use design is prompting infringement on parks and green regions, jungle gyms caused weak beach front normal regions to disintegrate regular obstructions that can decrease the adverse consequence of environmental change (Jasanoff, 2012). The Karachi metropolitan is among the world's quickest developing metropolitan regions, could gain ground in these parts of enhancements(Jenkins, 2014).

The worldwide spotlight on environmental change and the accessibility of critical related monetary assets furnish city supervisors all over the planet with an open door to get to assets, system and device strategies to not just groundwork for the possible impacts of environmental change yet ordinarily increment the strength profile of metropolitan. Typhoons: occurs in mid-year months going between April to June and from late September to November(Johnston). Southwest rainstorm: Season occurs

from July and to end of September. The rainstorm brought weighty downpours fall lead to weighty flooding in the metropolitan and suburban(Kęska et al., 2021).Western unsettling influences: Happens in the long periods of winter, making sprinkle showers and causing a slight decrease in temperature of metropolitan(Khan, 2011).

There are conflicts and clashed sees in regards to precision of numerous parts of gauges and advancements connected with climatic changes that the activities focused on now to address expected effects and results in the short and long terms future, an agreement of environmental change sway is heightening internationally. The earth surface is getting hotter worldwide and more outrageous climates, for example, hurricanes or weighty downpours with floods or delayed dry seasons recorded in previous years. Besides, the logical information showed that anthropogenic and mechanical mediation and impact is to a great extent liable for fast changes in both short lengthy terms atmospheric conditions universally, which might well push the Earth's environment to a basic place where a portion of the harms and leftover effects could come to be hopeless. This disturbing mindfulness currently loans an insight of global sincerity to foster most appropriate techniques, philosophies and frameworks to handle and address the environmental change issue.

The ozone harming substances like carbon dioxide (CO_2), methane (CH_4), water fume (H_2O), nitrous oxide (N2O), and (O_3) ozone are albeit in little focus contributed in atmosphere, do significantly affect environment: like the nursery impact(Khan, 2011).

These greenhouse gases send daylight at more limited frequencies while sifting through longer frequencies of brilliant energy, somewhat obstructing daylight once it arrives at the surface. The nursery is liable to keep up with the normal temperature of Earth's at around 15-18 °C (Khan, 1993).The normally kept up with nursery result makes life conceivable on Earth. However, anthropogenic occasions like consuming of non-renewable energy sources, land use design change, industry created contamination and the deforestation are among the cycles that have significantly expanded the nurseries gases focus in the environment and has additionally decreased the seas and vegetative cover capacity to assimilate ozone harming substances. The phenomenon is called fake or an added substance nursery

impact. In such manner, carbon dioxide assumes a significant part. Their commitment to the anthropogenic nursery impact is around 60%, which is around 3/4 of the anthropogenic ascent in carbon dioxide discharges fixations from the fossils fills copying(Khan et al., 2015).

The created world is liable for the collection of the majority of the outflows from environmental change since fast industrialization started in the late nineteenth century. Nonetheless, according to the advancement of destiny, effects of environmental change will be more extreme in numerous nations of the creating scene and the least fortunate of them are generally powerless against any shocks. Numerous nations because of absence of monetary assets for variation and alleviation endeavors and creation limit might be undermined by blunder.

The effects of environmental change are unevenly conveyed; the most unfortunate nations and individuals will be hit quickly. To start with, creating districts are in a tough spot: they are now hotter on normal than created areas and experience the ill effects of variances in precipitation. Second, emerging nations, particularly the least fortunate, are exceptionally subject to agribusiness, which is the most environment delicate area of the economy, and experience the ill effects of insufficient medical care and inadequate public administrations. Third, their low wages and weakness make it undeniably challenging to adjust to environmental change.

At the public level, environmental change will decrease pay and increment spending needs, prompting a disintegration in broad daylight accounts(Khaskheli, 2020). Environment possibilities for Southeast Asia are trying because of the district's difficult geography, which incorporates mountains, valleys, and seaside regions, comprising of central area, landmass, and islands; Linked regional communications among ocean and land; And an enormous number of interfacing climatic elements that lead to expanded neighborhood environment contest for accessible water assets(Kissel et al., 2014).

1.3 Impending Dangers and Effects by Environmental Change

Chance of climate related impacts emerges from the connection of climate related dangers (counting dangerous occasions and patterns) through weakness and openness of human and regular frameworks, including their flexibility. The rising rate and greatness of warming and different changes in the environment framework, joined by sea fermentation, increment the gamble of genuine, far reaching and at times, irreversible antagonistic impacts. While certain dangers are explicit to individual locales and others are worldwide. Generally chance of environmental change impacts in future can decrease by diminishing the rate and extent and sea fermentation. As far as possible for environmental change to the point of making unexpected and irreversible changes stay unclear, yet the dangers related with surpassing these edges increment with expanding temperature (medium certainty). For risk evaluation, it is vital to survey the largest conceivable scope of effects, incorporating far-fetched outcomes with huge qualities(Kitchen, 2016).

Most species face an expanded gamble of elimination by environmental change during 21st century, particularly when environmental change connects with different stressors (high certainty). For the most part plant species can't normally change their geographic ranges quick to the point of staying up with ebb and flow and extended high paces of environmental change in most landscapes. Most of little and freshwater warm blooded creatures cannot keep up in level scenes this century (high certainty)(Knutson et al., 2017). The future dangers featured by seeing that normal worldwide environmental change, at a rate lower than current anthropogenic environmental change, has caused significant biological system movements and species termination over the beyond a long period of time. Marine organic entities will slowly experience low oxygen levels and undeniable levels and mass(Kovats & Osborn, 2016).

1.4 Urbanization and Variation of Environmental Change Portion Enhancements

Government intervention with respect to regulatory regimes is vital and most effective tools.

1.4.1 Environmental Impacts

The different expected results of potential environmental change circumstances locales in the circumstance of the significant liabilities and environment changes impacts confronting the city of Karachi. Albeit a thorough and complete investigation of all features of the conversation matters was from the extent of this review. Endeavors made to manage the discussion and study design for each potential environmental change circumstance to evaluate impacts and distinguish major issues recognized(Kreft & Eckstein, 2013).

1.4.1.1 Impacts of Environmental Change on Water Assets

As in many other places on the earth, Pakistan is experiencing an increase in dangerous hydrological events in a variety of settings, particularly streak floods in the northern region's uneven streams. It was discovered during a water accessibility assessment of the Kabul Waterway Bowl, a snow melt-affected bowl, where there is a more polished top and a noticeable month-to-month fluctuation in the annual

highpoint stream. Another important finding of this Kabul Waterway Bowl assessment is a wider recurrence of larger extent yearly biggest stream events. One more work zeroed in on the Gilgit Stream Bowl, an icy mass took care of bowl, and it is uncovered that quicker dissolving of ice sheets under expanded temperatures would bring more water stream a month sooner yet with a leveled top.

In the Karakoram area, the particularly northeastern piece of Northern Pakistan, which contains the significant extent of the Pakistani icy masses, there is proof that the majority of the glacial masses are either progressing or stable (the renowned 'Karakoram Abnormality'). As of late Khurdopin glacial mass and the Shisper icy mass flooded down the slope at very quick rates, causing an obstructed to a streaming stream, accordingly shaping an impermanent lake with an eruption risk. Then again, a few regions, particularly in the Hindukush mountain range (Chitral and western Gilgit)(Kreft & Eckstein, 2013) e.g., the Chitaboo glacier in Chitral has withdrawn quickly lately because of a worldwide temperature alteration.

Environmental change investigation demonstrates that the pace of progress of normal temperature in the northern piece of Pakistan is higher than that for southern Pakistan. A higher pace of increment of temperature in Pakistani mountains is causing the liquefying of its icy masses at lower heights, particularly in the Hindukush locale (Western pieces of Gilgit and Chitral). It is leading to the arrangement of frosty lakes roughly lower portions of icy masses as an immediate result, and presenting Icy Lake Eruption Floods (GLOFs)(Laffoley & Baxter, 2018) danger that is quite possibly the most decimating mountain debacle.

1.4.1.2 Impact of Environmental Change on Horticulture and Food Security

Environmental change can affect food quality, reduce access to food, and disrupt food accessibility. Reduced farming utility may result from extended temperature increases, altered precipitation patterns, altered extreme weather events, and decreased water accessibility. Studies using crop reconstruction models show that

by the middle and end of the century, distinct Intergovernmental Board on Environmental Change (IPCC) scenarios will result in significant losses in the yields of wheat, rice, and maize in Pakistan's arid, semi-dry, and downpour-affected areas.

During the Rabi and Kharif seasons, there will often be a rising pattern in the normal greatest temperature for both Delegate Focus Pathways (RCPs), with 1-2.00C for RCP 4.5 and 5-60C for RCP 8.5. Temperatures in the Southeastern piece of Pakistan have displayed to surpass the limits at the hours of blossoming and maturing, consequently causing wheat yield misfortunes. Because of climb in temperatures, a general increment of 1000 Developing Degree Days (GDDs) among authentic and late century outrageous situations (RCP 8.5) has been seen if there should be an occurrence of wheat, inferring that South Eastern side of Pakistan is probably going to become inadmissible for wheat creation because of temperature limits after mid-century.

Studies conducted using the Agrarian Creation Frameworks Test system (APSIM) model also indicate that wheat production in Pakistan's arid regions is likely to decline by 17% in the 2020s in the event that RCP 4.5 occurs, and by 21% and 40% in the event that RCP 8.5 occurs for the 2020s and 2080s, respectively. If condition RCP 8.5 were to materialize in the Khyber Pakhtunkhwa(KpK) region before the end of the century, water crop model activities would drop in yields of maize by 34% and by 41%(Lockwood, 2018).

The outcomes propose that the total effect of climatic boundaries, i.e., changes in temperature and precipitation, applied a general adverse consequence on oat crop yields, and considering that the administration practices and utilization of innovation stay unaltered. The agribusiness area is the second biggest area adding to GHG discharges (174 out of 406 Mt CO_2Eq)(Long et al., 2006). As indicated by pattern outflow (of 2015) projections, agrarian development is relied upon to increment up to 271.9 (56%) Mt, 314.3(80 percent) Mt and 362.9(108%) Mt of CO_2-identical under the same old thing and Food Security (FS) and Improved Utilization Example (ECP) situations, individually.

Displaying environmental change scenarios for Pakistan demonstrates that, even under the best-case scenario, the future livelihoods of ranchers and the rural areas of Pakistan will be seriously threatened by rising temperatures and changing

precipitation. FAO will try a venture on the issue for overall supervision "Agribusiness, water, and environmental toughness are changing the Indus Bowl. By encouraging greater flexibility among the most vulnerable ranchers and strengthening the public authority's capacity to support their networks in making adjustments, the task objective is to alter horticulture in the Bowl. The project will be carried out over a six-year period in eight regions of Punjab and Sindh Areas at a total cost of $47 million, which will be provided by the Green Environment Asset and co-financed by both common states(Ludwig et al., 2007). The project will directly benefit about 1.3 million rural residents, especially female ranchers and professionals involved in project limit improvement.

By varying current and clean innovation, increased land usage could help to mitigate the impact of environmental change on farming. Green Upheaval strategies have pushed the use of innovation to modernize rural creation and create food-independent economies in several parts of Asia.

1.4.2 Environmental Change and Urban Communities

The solid association between environmental change and suburbanization is not much, yet the extent of the issue is as of now further clear. If one significant event recognized as having the most pivotal impact on the sensational change in the natural equilibrium on the planet, then, at that point, this would need to be the start of the period of industrialization. Since the start of the modern time frame, carbon dioxide and methane (CH_4), focuses have expanded by 70% somewhere in the range of 1970 and 2004, and metropolitan focuses have played a significant, yet not totally implicit and part in this procedure(Mahar & Zaigham, 2010). Civil zones cover just 2.8% Earth's shallow, however from 2008, further half world's general population lives in city districts(Majaw, 2020). Quick urbanization is essentially occurring in creating states; any place huge segment shifts have significant inductions in regular assets relations, destitution, and climate. By recently printed report of UN-Territory.

1.4.3 Scenarios of urban communities and environmental change

The small portion of anthropogenic ozone harming substance sets free from cities can go from 40 to 70 percent in the event that utilizations in light of (i.e., numbers determined by adding ozone depleting substance outflows from production lines situated in urban communities)(Malik et al., 2020). This analyzes to 60-70 percent if an ingestion-based technique is utilized. The vital bases of ozone harming substance set free from city regions are related with the non-renewable energy sources utilization. It incorporates power supplies for creating power (chiefly from coal, gas, and oil), Transport, Energy use in business and local locations and structures for lighting, cooking, space warming and cooling, enterprises. The speed of advancement in this day and age is uncommon, with metropolitan populaces moving toward an almost fivefold increment somewhere in the range of 1950 and 2011. While these numbers might be stressing enough, the greatest misery is the component that a large part of the advancement in the metropolitan people is unified (Mangi et al., 2020). In eminent and less created nations that are least ready to acclimate to possible outcomes. Non-industrial nations are presently home to around 3/4 of the world's metropolitan populace; over 90% of world's civil people development is currently taking residence in emerging nations. Thusly, world's arising megacities are prevalently urban communities with a high centralization of development, gathered in relaxed settlements and favelas, and frequently with profound lacks in administration, edge, and society at large (Mannucci & Franchini, 2017).

The worldwide reaction to the environment challenge presently centered on the turn of events and execution of relief and modified plans. Alleviation in the point of view of environmental change implies lessening, catching, and putting away ozone depleting substance (GHG) emissions (Masood et al., 2015). Subsequently, metropolitan settlements and settlements in created nations assume a focal part in the preparation and execution of moderation techniques. In light of meanings of Intergovernmental Board on Environmental Change (IPCC), it is perceived that transformation to environmental change (for instance, anthropogenic or anthropogenic

incorporates all actions to diminish the vulnerability of an organic entity

1.4.4 Climate Change Dangers for Pakistan Under The 2012 National Climate Policy

Significant expansion in the recurrence and force of outrageous climate pattern occasions with sporadic rainstorm downpours, which cause every now and again extreme floods and dry seasons; The extended retreat of the Hindu Kush-Karakorum-Himalayas (HKH) glacial masses because of a worldwide temperature alteration and testimony of carbon dioxide from trans boundary contamination sources compromising water streams into the Indus River System (IRS); Increased siltation in huge dams due to often and extreme floods (Mátyás et al., 2018).

Due to climbing temperatures prompting expanded heat and upsetting water conditions particularly in bone-dry and semi-dry regions prompting a decline in rural usefulness; Further decrease of currently scant woods cover due to extremely fast changes in climatic circumstances, which drove the regular movement of impacted plant species;

Increased seawater intrusion into the Indus Delta are effecting, mangroves and fish population; Threats to seaside regions from expected ocean level ascent and expanded tropical storm movement because of increasing ocean surface temperatures of 1.7 and 1.8. Increase in strain between the upper and lower scopes of waterways with the utilization of water assets working closely together; increased wellbeing dangers and environmental change are driving movement.

1.5 Objective

The review expects to assemble an image of the prior environment changes writing and work out the anticipated impacts of environmental change in Karachi.

Further more Risk evaluations considering impacts of climate change in the city.

a. To collect data regarding ambient air quality, temperature and heat waves
b. To develop statistical and risk assessment models through air quality, temperature and heat waves

1.6 Scope of Study

Environmental change is a significant peculiarity looked by the world overall and a few areas of the planet specifically. Examination in regard to environmental change is a yearly action in various nations of the world to get ready for the difficulties and anticipate any danger/opportunity coming. This study will utilize the generally accessible information with respect to Temperature, dry season, heat waves, flooding, and other significant variables. Assessment of impacts by the emphasis on, temperature, dry spell, heat waves, and flooding. Appropriate measures will be determined as a suggestion for the minimization of dangers.

1.7 Novelty of the study

Air pollution is incremental in climate change as the emission is contributing to GHG. Risk assessment is a tool to futuristically forecast and also calculate the long and short term effects on a particular area and its surroundings. Karachi being the biggest and most industrialized city is also feeling the consequences like heat wave, flooding, drought and rising temperature. This thesis has done risk assessment as mostly done in developed countries to prepare accordingly for predictable outcomes.

Chapter 2

LITERATURE REVIEW

2.1 Literature Review

In recent years, assessing coastal risk has taken precedence over all other aspects of strategic planning and management. Coastal locations are highly vulnerable to risk factors and are prone to a progressive deterioration of the natural asset, which has an impact on coastal community lifestyle and economic development. These places are also under threat from increasing urbanization and widespread exploitation, which weakens the ability of regions to recover from dangerous catastrophic events made worse by climate change. Furthermore, due to the extensive coastal areas that need to

be preserved, economic investments are frequently not viable for public administrations (McAllister et al., 2011). The recognition of the physical processes causing erosion and floods is not the only factor in the study of critical environmental or safety issues; it is also heavily dependent on the characteristics of both the natural and human environments and how they interact. A cause-and-effect cause and effect sequence must be followed in order to achieve a proper balance between human, environmental, infrastructure, social, and economic variables, enabling a multidisciplinary and integrated picture of the entire environmental processes (McAllister et al., 2011).

The complexity of relationships among several sources of climate change risk and of how multiple risks compound or cascade are highlighted by real-world experience. But there is still no comprehensive framework for evaluating these intricate climate change concerns. It is important to understand the interactions that lead to risk, particularly how adaptation and mitigation measures play a part (McCoy et al., 2014). Experts are increasingly thinking about the threats that could come from climate change impacts and our response to them. This promotes persuasive thinking that crosses sectoral and regional boundaries and links socioeconomic and physical risk factors. Conducting a risk assessment for climate change is essential for rational decision-making that reduces the adverse effects of climate change.

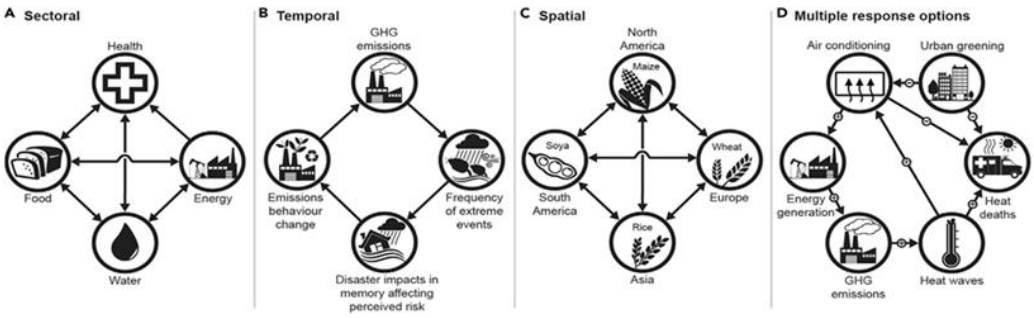

Figure.2.1co relation of factors of parameters (Mendelsohn & Dinar, 1999)

There are numerous material and mental barriers that interactions can pass to either reduce or increase the dangers of climate change. Examples include (A) cross-

sectorial interactions, such as those involving water, energy, food, and health; (B) temporal lags, such as those involving climate extremes and behavior change; (C) spatial telecoupling, such as that involving food trade networks and breadbasket failures; and (D) interactions of various mitigation and adaptation response options, such as the use of fossil fuel-powered air conditioning and urban greening as responses to extreme heat 2021(N. Schmidt15Soni).

Table 2.1. Types of complex risk with IPCC definition

Compound risk	Hazards that interact with exposed systems or sectors might be defined by a single extreme occurrence, numerous concurrent or sequential incidents, or both. Compound risks result from these interactions.
Emergent risk	a risk that develops from the interaction of phenomena in a complex system, such as the risk brought on by population shifts due to climate change that raise populations' sensitivity and exposure in the receiving region.
Systematic risk	Networked risks that are connected together might result in systemic risk, where a localised initial failure could have catastrophic consequences and, at its most extreme, create unlimited damage4.

Table 2.2. Types of complex risk with no IPCC definitions)

Types of complex risk with no IPCC definitions	
Aggregate risk	the accumulation of independent determinants of risk
Amplified risk	The significant increase in background risk caused by the combination or concentration of risk factors in one area or period.
Cascading risk	Interactions can be one-way (e.g., domino or contagion effects), but they can also involve feedbacks; one event or trend setting off others; Cascading risk is frequently linked to the risk's vulnerability element, such as essential infrastructure.
Interacting risk	the intersections of risks, their mutual influences on other factors, and their effects on environmental drivers
Interconnected risk	the intricate relationships between social interactions and physical interdependencies in the human, environmental, and technology systems 38
Interdependent risk	Complex systems involve inextricable linkages and dependencies that increase the likelihood of a variety of unpredictable risks.
Multi risk	The total risk from several hazards, accounting for potential interconnections between hazards and vulnerabilities, requiring both multi-hazard and multi-vulnerability perspectives40.

One of the main threats to the sustainability of life on Earth is the planet's rapidly changing climate. One of the primary causes of environmental degradation is the occurrence of global warming. In addition to contaminating the air, the excessive release of greenhouse gases (GHG) into the outer atmosphere caused by the burning of fossil fuels raises the average temperature of the planet (Mendelsohn & Williams, 2004).

Due to the disruption of Earth's climatic processes brought on by climate change, which also affects the economy, floods, famines, droughts, and cyclones, among other natural disasters, are among the effects on human life(Meteorology & CSIRO, 2014). Through a number of interconnected systems that are also influenced by other human factors and non-climatic health issues, climate change has an impact on human health (WHO 2014). The developed world is responsible for a large portion of the accumulation of emissions causing climate change because they began rapidly industrialising at the end of the 19th century. In an ironic turn of events, the poorest people are the most vulnerable to any shocks and the effects of climate change are felt most severely in many developing nations. Many of those nations lack the funding

necessary for eradication and mitigation initiatives, and some of them have bad governance that makes it difficult for people to act appropriately.

Wide-ranging effects of climate change are predicted for Pakistan, including decreased agronomic productivity, increased water availability fluctuation, increased coastline erosion and seawater intrusion, and increased frequency of extreme climatic events. The poorest countries and people will be most affected by the effects of climate change. First, developing countries are geographically disadvantaged because they are already warmer than developed countries on average and suffer from significant rainfall variability. Second, emerging nations, especially the poorest, are primarily dependent on agriculture, the economic sector most vulnerable to climatic changes. They also suffer from inadequate health care and occasionally outstanding public services. Thirdly, a model to change the climate is challenging due to their low incomes and vulnerability. Climate trade will harm public finances on a national scale by lowering revenues and increasing spending desires. While there is still debate and divergent views regarding the degree of accuracy of various forecasts and circumstances related to weather change, as well as the steps that must be taken now to test potential effects and implications in the future, there is still growing agreement that the world's weather is changing(Meteorology & CSIRO, 2014). Due to its topographical location, Pakistan is ranked among the top ten nations that have had the greatest impact from climate change over the past 20 years, according to German Watch. The world is getting hotter, and extreme weather events like tropical typhoons, heavy rain that causes flooding, or protracted dry spells have become better recently. In this case, it's important to keep in mind that the humanoid impact is mostly to blame for the rapid changes in climatic patterns that are capable of pushing the earth's temperature past a point at which some undesirable influences and results may also become irreversible. This distressing understanding is currently offering an intellect of worldwide insistence for planning suitable systems, methods, and procedures to fulfil this study. Gases together with carbon dioxide (CO_2), nitrous oxide (smiling gas N_2O), methane (CH_4), ozone (O_3) and water vapour even although most effective display up in appropriate mild quantities within the earth's atmosphere, have a large effect on weather (Miralles-Wilhelm et al., 2017). They permit sun waves of smaller wavelengths to skip, even as sieving extensive wavelengths of radiant electricity using in part placing the solar waves after attainment the superficial. These

gases referred to as inexperienced house gases. It is liable for the herbal inexperienced house impact that maintains the earth's common temperature at around 15^{o}C without them about 18^{o}C.Herbal green residence consequences ares whatever marks lifestyles on the planet conceivable (Mohammadi et al., 2020). Climate change has direct effects on human health at the separate level as evident in infectious and vector borne diseases such as malaria and cholera. At community, local and worldwide levels, human health is endangered by deteriorating water quality, increased air pollution, soil degradation, and changes to safety and shelter for those forced to move.

Climate change also affects health indirectly by influencing the determinants of socioeconomic, physical, and mental wellbeing.Human activities, which include the burning of fossil fuels, business pollutants, deforestation, land-use variations, and amongst further, have greater drastically the absorptions of GHGs inside the air, composed with a decline of the potential of vegetation and oceans to take in GHGs. It mentioned to as a further or guy-made inexperienced household consequence. Concerning this, CO_2 performs an important function. Its contribution within the greenhouse impact is a region at about 60% around three-quarters by anthropogenic boom in CO_2because of burning of fossil fuels (Mohammadi et al., 2020).

Climate projections for Southeast Asia are alarming because of the area's complex terrain, valleys, comprising mountains and coastal zones throughout a various mix of mainland, peninsulas, and islands; the related nearby sea-land interactions; and the large number of interacting weather drivers that supply upward push to the neighbourhood climate. The gamble of climate related outcomes from the interaction of environment related dangers with the weakness and exposure of human and normal frameworks, comprising of their capacity to adjust. Because of increasing expenses and extents of warming and alterations inside the climate framework joined by utilizing sea fermentation, blast the opportunity of extreme, unavoidable and now and again irreversible hindering impacts. Particularly a few dangers are significant for an individual, while others are worldwide. The overall dangers of environmental change impacts diminished by utilizing restricting the charge and meaning of weather conditions substitute, comprising of sea fermentation. The right scopes of environment substitute to the point of making fast and irreversible change proceed be uncertain, nonetheless, the risk connected with passing such boundaries worth will

increment with climbing temperature(Mustafa, 2011). Since high temperature and precipitation are straight contributions in agronomic creation, many accept that the biggest impacts will be on horticulture. Notwithstanding, the creation ascends in the higher scopes in view of an expansion in arable land and will in general fall in the jungles due to decrease in the accessibility of water (Nabi et al., 2019).

A gigantic part of animal categories faces sped up annihilation danger due to weather conditions substitute throughout and past the twenty-first century, particularly as weather conditions substitute connects with different stressors. The future risk is shown to be inordinate utilizing the discourse that home grown overall environment substitute at statements decline than current anthropogenic weather conditions exchange welcomed on sizeable climate movements and species annihilations at some stage in the past large number of years (Nadakavukaren, 1990).

Marine living beings will confront methodical abatement oxygen reaches and high charges and extents of sea fermentation with related risks exacerbated via developing sea temperature limits. Coral reefs and polar biological systems are particularly weak beach front regions are at danger from the ocean level vertical push, for protect for a really long time regardless of whether the worldwide propose temperature is settled (Nadakavukaren, 1990). The environmental change can upset food frameworks in various ways: containing the immediate consequences for crop creation incorporates (e.g., changes in downpour prompting lack or flooding, or hotter or cooler temperatures prompting changes in the length of developing season) impacts on business sectors, food costs and store network foundation. Environmental change assumes essential part in the viewpoint of food security. Weather conditions trade projected to subvert food security. Because of extended weather conditions trade by utilizing the mid-21st Century and past. Overall marine species rearrangement and marine biodiversity rebate in delicate areas will mission the supported arrangement of fisheries efficiency and other environment contributions (Naheed & Rasul, 2010).

For agrarian (wheat, rice and maize) in tropical and state of mind ate regions, environment trade without variety is projected to contrarily affect creation for adjacent temperature increments of 2°C or more prominent above late 20th century stages, despite the fact that character areas might benefit. Worldwide temperature increments of 4°C or more above past due twentieth century levels, mixed with

developing food call for, would present colossal threats to sanitation universally. Environment exchange projected to decrease sustainable surface water and groundwater resources in greatest dry subtropical locales(Naheed & Rasul, 2010).

2.2 Urbanization and Climate Trade

Higher temperatures will be hurtful for the greater part of the unindustrialized nations, on the grounds that in these nations, water is deficient, and temperatures are high (Nazir & Lohano, 2022). Because of these angles, an expansion in temperatures will make numerous agronomic districts less useful and, surprisingly, inconsistent for creation (Nazir & Lohano, 2022) presumed that as the cool wheat-developing regions get hotter, the higher temperatures would lessen the grain yields.

The solid connection between environment exchange and urbanization is the same old thing yet the massiveness of the endeavor is ending up being unmistakable. In the interim the start of the Business innovation centralizations of carbon dioxide (CO2) and methane (CH4) have augmented with a development of 70% all through 1970 to 2004 term and substantial offices performed principle albeit no more yet totally expected work in this framework. City areas overcome only 2.8% earths shallow however in an additional 2008 than half of the world's general population squat city zones. Quick improvement is occurring in huge part in creating states where a tremendous segment change has huge repercussions in lies of destitution, natural sources, and the environmental factors.

2.3 Urbanization and Weather Conditions Change

The small amount of human caused greenhouse gases (GHG) releases in view of urban areas will be among 40% and 70%. This is in an evaluation with as high as 60% to 70% if an ingestion-based approach is utilized. The principal bases of GHG releases from city areas are related to the ingestion of petroleum products. They include power conveyance for power innovation (particularly from Oil , Coal, fuel); transportation; power use in lodging structures for brightening, space warming, cooking; business producing. The rhythm of urbanization inside the worldwide these days is outstanding, with a close by city people among 1950 and 2011. While those insights may be troubling adequate what's an explanation of bigger trouble is reality that limit of the expansion in city people is engaged in the developing and least settled districts and are smallest equipped to adjust to the likely outcomes. The developing worldwide areas these days assembly right around 3-fourth of the world's regions and extra than 90 as indicated by penny coin of the world's metropolitan people and extra than 90% of the field's city people advancement is by and by taking area in developing regions. The rising megacities of the world are therefore much of the time individuals who have over the top convergences of increment centered in simple repayments and purlieus and routinely have intelligent disparities in power, structure, and financial and local area unprejudiced nature (Nergis et al., 2017)

The worldwide response to the environment mission pitched nearer to developing and forcing mitigation and model methods. Moderation inside the circumstance of weather conditions trade notices to the abatement of nursery gas (GHG) releases and their size and putting away spotlight on alleviation technique to (Niazi, 2015) improve and carry out. Drawing on the meanings of the intergovernmental board on weather conditions trade, adaption (human-caused or anthropogenic) climatic exchange is perceived to incorporate all activities to diminish weakness of a gadget, populace foundation (for example Helpless people in a city) or a person or local area save of the antagonistic impacts of expected environment exchange. Mitigation and strategies are fundamental not be estimated in opposition to

each promote moderately they supplement each other in that having some expertise in one additionally builds up the capacity randomly of the inverse.

Developed and European nations do risk assessment on yearly basis (Kovats et al. 2017). This examination as of now not best aides in regions sorting out of weaknesses anyway moreover draws a picture of chances. Research executed on overall scale focuses that the temperature of South Asia and South East Asia will go from 2 to four degrees Celsius and on an immediately premise endeavors are needed for 0.8 Celsius up push(Nielsen et al., 2021). It is seen that in the event of India and Brazil, albeit the cultivating area is exceptionally perplexing to environment however the singular ranchers really do consider neighborhood environments and they attempt to limit the impacts of a dangerous atmospheric deviation. Later on a large portion of the market area effects of environmental change have a slope formed relationship with temperate. The aftereffect of any casualty is adaptability and assessed from organizations/ companies, city society offices, houses, and individuals with dangerous resourceful capacity. For towns or explicit city areas, it shows a capacity to hold center attributes inside the statement of risky scares and impacts, especially for powerless peoples. It ordinarily requires a possibility to expect climate variety and technique wished varieties. It for the most part needs an ability to accept environment exchange and plan wished expansions. The adaptability of any general population foundation to environment substitute collaborates with its flexibility to various unique tensions, like financial trade, fight, and savagery.

A key mindfulness is at the memorable need the way that the setting of weather conditions exchange gives urban areas wherever in the globe a doable choice to take advantage of on an opening of chance that has out of the blue unfurled to control inconveniences that we need to goal environment substitute stage. This stage chats the various likely meanings of possible environment substitute conditions situated inside the circumstance of the significant openings and environment substitute version requesting circumstances defied in Karachi city(Oanh et al., 2006).

Karachi city the greatest urban area of Pakistan providing the most extreme complex arrangement of metropolitan improvement requesting circumstances wherever still up in the air in Pakistan. The assessment in all actuality does never again gift and variety strategy in itself rather it arranges a movement for bearing on

the investigations of our city blast in the standard blueprint of growing a total city environment exchange variety technique. Its desires to perceive and organize the people and assets at plausible peril and the significant thing exercises fundamental for constructed Karachi a more noteworthy solid city comparatively to perceiving the significant formal, administration, specialized holes, and limitations(Oanh et al., 2006).

Generally lands of Pakistan inundated by utilizing Indus. The nation is inclined to weather conditions substitute with downpour and blizzard on the higher height. Snow in The Frozen North contributes the most to the ocean level vertical push saw with the guide of the Cold and Asia. Particular models intended to foresee the substitute and expect the environmental change with assessment and lightening. The review and measurements propose that Pakistan has the absolute most obvious opportunity cost for clashes and human openness to these dangers.

It diverted into likewise clear from records that weak organizations (6.5/10 danger esteem) and evacuated people (eight/10 possibility esteem) due to environment exchange have the best weakness chance expense. The local networks of noticed areas are at unreasonable risk of improvement hardship and financial difficulties (6/10 peril esteem). On a scale from one to 10 Pakistan's normal, have the risk, weakness and absence of adapting limit upsides of 9.00, 5.20 and 5.70 individually(Oanh et al., 2006). As currently referenced the motivation behind this concentrate as to convey comprehension and are expecting intimidations and opportunities for environmental change for Karachi.

2.4 Temperature and Drought

Pakistan is among the apex ten worldwide areas in danger of weather conditions substitute. The presented to inordinate events of Dry spell/Floods (Oost et al.). Pakistan is a subtropical use with dry to semi-dry environment is more prominent

slanted and the US has seen long droughts or drying design. Water shortage to a limit confine is a danger; currently noticeable in numerous areas of Pakistan and the US is presently water-scant. Pakistan is more water-focused than Ethiopia. Pakistan is going through a constant variance in climate America and downs, temperature change propensities are accessible in remarkable time terms. Temperature maxima and minima associated with global ecological elements. Temperature in Karachi stays endurable in light of ocean parts. Propose Yearly least and greatest temperature shifts between 20-25°C and 32-34 °C individually (OR, 2018)

The rural terrains of Karachi are other than Malir, Sukkan, and Center point water ways and comprise of Deh Hudarwah, Thano, Malh, Langheji, Konkar and Thaddo. Karachi changed into acclaim for its gigantic scope of significant worth added fabricating in 70's. Malir area transformed into horticultural based items like (Guava, Mango, Mulberry, Papaya and bananas) and vegetables (Brinjal, Tomatoes, Spinach, Pumpkin, Okra)(Niazi, 2015). There might be a major decrease in products of the soil fabricating in light of water shortage. Way of precipitation is different, which makes it untrustworthy for downpour related farmland of Karachi. Pinnacles of precipitation have become viewed as in 1994, 2007, and 2010 individually, while cycle 450 mm precipitation brought around wide unfurl annihilation as blaze floods in Karachi(Pakistan, 2016). Positively, due to human exercises, the recommended temperature at the outer layer of the earth has been expanding throughout the most recent century(Pakistan, 2016). It guessed that warm late spring days have moreover come to more drawn out and consistently in a couple of parts of the globe. The extended floor temperature is the principle to the development in vanishing from the seas and land. Subsequently, there may be a development in worldwide normal precipitation. A couple of locales also appreciate dry seasons in view of extreme vanishing ranges and moving of wind designs while certain areas of the planet get streak floods. Regardless, it is miles extremely intense to recognize regardless of whether home grown or human impacts (Gadiwala & Sadiq, 2008) because of an extraordinary weather conditions event.

In accordance with realities collected through the Pakistan Meteorological branch from 1985 to 2014, Karachi's normal yearly precipitation stages from 10 to one hundred fifty mm(Pakistan, 2016). To show this peculiarity, 2014 went down as

probably the driest year on the report in the course of the keep going two or three long time in Karachi, with complete yearly precipitation falling under 50 mm. This dry yr remains in obvious evaluation to the 142 mm of precipitation Karachi procured in a range of essentially 24 hours in July 2009. Patterns of dry spell and serious precipitation in the city protect to give a tremendous danger to Karachi. This vulnerability in recognizing precipitation qualities in Karachi likewise presents a fundamental dare to calamity readiness inside the city (Change, 2013). Water convey: water resources are as of now at risk in the thickly populated town of Karachi. With regards to most investigations that survey the risk recommend that a for a warming of around 3°C pre-business levels by 2080, it's miles potentially that with regards to capita water accessibility will bring down via more noteworthy than 10 % in view of a total of people blast four and weather conditions change in south Asia. In any event, warming among 1.5 to 2.0 fundamental changes in water stockpiles could be found and to counter the equivalent significant interests in water capacity building would be expected to utilize the ability endowments of raised occasional spill over and make amends for decline seasons streams, to oblige for during water accessibility(Chaudhry, 2018).

2.5 Crop Yields

These are vulnerable to a number of climate-related factors in the area, including seasonal water scarcity, warming temperatures, and saline intrusion due to sea-stage rise. Reduced relative yields of rice, Asia's most important crop, especially in rainy areas, are a result of rising temperatures and changes in rainfall patterns. Plants grown for food have been found to be sensitive to temperature increases. When comparing estimations of potential yields without historical patterns of temperature changes from the 1980s, one finds that rice and wheat yields have decreased by about 8% for each 1°C increase. Another study discovered that the combination of warmer evenings and less precipitation at the end of the growing season has resulted in a

sizable loss of rice production; yields could have been about 6% greater in the absence of the historical change in climatic conditions. While average yields have increased over the past few decades, in the last ten years, concerning indications and symptoms of agricultural yield stagnation on sizable cropland regions have developed (Raza et al., 2019).

The study in extreme warmness affecting 10% of the overall land region with the aid of 2020 and 15% via 2030 poses an excessive hazard to crop yields. Crop yields projected to lower drastically for warming within the 1.5-2.0°C variety; if there may be a sturdy CO. Fertilization impact, however, the Poor effects of warming probably offset in part with the aid of low-price variation measures. Above 2°C warming's above pre-industrial stages, crop yields are projected to lower around 10-30 %for warming of 3-4.5°C, with the biggest reductions in the instances where the CO; fertilization impact is weak (Chaudhry, 2017).

Crop production without weather trade is projected to boom appreciably (using 60%) in the vicinity and be under accelerated rate pressure and a trend aspect expressing technological enhancements, research and development, an extension of markets, and infrastructure. Beneath 2°C warming's through the 2050s, the growth can be decreased with the aid of as a minimum of 12 %, requiring more than two times the imports to fulfil in keeping with capita call for than is needed without weather exchange. Lowering meals availability can lead to enormous fitness troubles in affected populations, including adolescence stunting, which projected to boom via 35% with the aid of 2050 as compared to a scenario without climate trade(Oreskes, 2018).

Khirthar Park the largest national park in Pakistan comprising numerous vulnerable and guarded vegetation and Fauna. Now not numerous human beings are conscious that a portion of the Khirthar countrywide Park Establishes 20% of the Area Karachi landform as an outcome of small average yearly rain, and the attention of precipitation in a early monsoon season, there are no perpetual streams inside Park. Groundwater discharging from spirals or haggard from boreholes affords the individual basis of water to maintain wild and national animals, irrigation, and human consumption in the Khirthar countrywide Park(Parekh et al., 2001).

Within the 12 months (2000), a baseline environmental look at the khirthar countrywide Park turned into conducted through a team of experts and researchers from university of Melbourne, Australia. As portion of the observation, Ground Water Modelling turned into additionally finished that showed hazardous water equilibrium with the water possessions by now underneath extreme strain. It became originate that the precipitous inclines and quick duration of watercourses inside the mountains will bring about a completely short time of attention for overflow and therefore, there might be only a brief length for Permeation complete the beds of mountain streams, consequently, slight recharge is predictable in the mountains (Partain et al., 2016).

It predicted that overall consumptive usage of water by way of vanishing from moistened land in the park changed into among 10,000 - 20,000 MUA. This changed into 10-25 MUA instances extra than the amount drawn for consuming (round 800 ML/a), water resources for home animals (around 270 ML/a), or occupied by way of wild animals (around 40 ML/a). Groundwater recharge to aquifers within the Tuang Valley turned into expected to be about 9,000 MUa, but extraction for irrigation becomes originate to be about 28000 ML/a. Even though figures it becomes said were focus to mistakes of approximation however it became, in reality, obvious that the floor water sources of the Tuang Valley inside the Park have been by now over established (Partain et al., 2016). Consequences of climate change (e.g., maximum temperature, minimum temperature, rainfall, relative humidity, and the sunshine) on the main plants of Pakistan (e.g., wheat, rice, maize, and sugarcane). The methods of feasible generalize least square (FGLS) and hetero scedasticity and autocorrelation (HAC) constant popular mistakes have hired the use of time collecting data for the period 1989 to 2015. The consequences of maximum temperature are adversely effecting wheat production at the same time as the impact of minimum temperature is agreeable and vast for all crops. Rainfall impact closer to the yield of a selected crop is bad besides for wheat. To deal with and mitigate the destructive effects of weather exchange, there may be a want for the development of heat- and drought-resistant high-yielding sorts to ensure food security within the country. A study was conducted by from a place and territorial statistics groups from 1976 to 2005 have been analysed to inspect the variations and tendencies in wintertime mean lowest temperatures of Pakistan. Countrywide investigation demonstrations that there is a minor growth in mean

lowest temperature; nevertheless, the growing tendency is weak. A rise in the mean lowest temperature is a pointer of climate change. It is apparent that in the large metropolises and simple zones of the country altering the behaviour of wintertime will carry into act diverse healthiness and agro-environmental contests.

A special pattern of changes in climatic standards within the coastal areas of Sindh Pakistan whose vulnerability is pondered by several intense meteorological activities that have now not the handiest prompted physical and organic environments of the location but has also answerable for extreme socioeconomic troubles. With a purpose to interpret climatological impacts, each remote sensing and ground-reality measurements hired. The metrological parameters used inside the examination had been minimal temperature, maximum temperature, and rainfall. The impact of those on available water assets, vegetation, landmass and dry land, and degradation of the Indus delta tested. Every year implies most temperatures fluctuated between 32.3°C to 35.1°C, even as that of minimum means temperature ranged between 18.8°C to 20.8°C. It revealed that the minimum temperature changed closer to the better side. The common rainfall becomes quite low and the area is dealing with intense drought because it lasts three a long time with occasional cloud bursts.

An increase in the maximum temperature of Karachi due to urbanization has been observed (Peskett et al., 2020). He uses the SARIMA model to forecast the maximum temperature of Karachi city, however, various other statistical methods could be employed to measure the temperature; we assess the maximum temperature with the time series analysis. Several other researchers have used this method to analyse temperature ((Peskett et al., 2020).

Sequence statistics of mean maximum temperature (MMxT), mean minimum temperature (MMiT), and mean annual temperature (MAT) from 1947 to 2005 to determine that the temperature change in Karachi was intentional (59 years). Data is divided into three sections for analysis using linear regression and anomalies from all time periods: (a) the entire period from 1947 to 2005; (b) phase one from 1947 to 1975; and (c) phase two from 1976 to 2005. Between 1947 and 2005, MMxT climbed by around 4.6°C, MMiT remained unchanged, while MAT increased by 2.25°C. Between 1947 and 1975, the MMxT climbed by 1.9°C, the MMiT decreased by

1.3°C, and the MAT increased by up to 0.3°C. The MMxT, MMiT, and MAT all increased between 1976 and 2005 by 2.7°C, 1.2°C, and 1.95°C, respectively.

A research exposed that important variations in precipitation and temperature risky have been noticed from 1961 to 2004. The consequences of a current study led by demonstration that there is an rise of around 1°C to 1.1°C in the mean temperature of India in the past era, in winter and post-monsoon months correspondingly. The rise of 1.15°C, 0.56°C, and 0.09°C in mean temperature has been experiential in Punjab, Baluchistan and Sindh correspondingly throughout the period 1960 to 2007 (PAKISTAN, 2017) discovered that daily minimum and maximum temperatures have enlarged all over Pakistan in the winter and summer periods.

Drought hazard and shortage of water supply can be connected for an extended interval inside the examine location, lifestyles of drought is in part due to climate alternate and partly due anthropogenic activities inclusive of adjustments within the water and land use sample, enormous desertification and sick controlled guidelines and making plans.

2.6 Heat waves

Date	°C	Date	°C	Date	°C	Date	°C	Date	°C	Date	°C
2012-01-01	25	2014-02-01	23	2016-03-01	24	2018-04-01	25	2020-05-01	28	2022-06-01	28
2012-02-01	23	2014-03-01	22	2016-04-01	24	2018-05-01	27	2020-06-01	29	2022-07-01	29
2012-03-01	22	2014-04-01	24	2016-05-01	27	2018-06-01	27	2020-07-01	32	2022-08-01	28
2012-04-01	25	2014-05-01	27	2016-06-01	27	2018-07-01	30	2020-08-01	31	2022-09-01	28
2012-05-01	26	2014-06-01	26	2016-07-01	30	2018-08-01	25	2020-09-01	29	2022-10-01	28
2012-06-01	26	2014-07-01	27	2016-08-01	27	2018-09-01	25	2020-10-01	28	2022-11-01	28
2012-07-01	25	2014-08-01	26	2016-09-01	26	2018-10-01	27	2020-11-01	28	2022-12-01	27
2012-08-01	25	2014-09-01	27	2016-10-01	27	2018-11-01	28	2020-12-01	26		
2012-09-01	26	2014-10-01	27	2016-11-01	27	2018-12-01	27	2021-01-01	24		
2012-10-01	28	2014-11-01	28	2016-12-01	26	2019-01-01	25	2021-02-01	23		
2012-11-01	28	2014-12-01	27	2017-01-01	25	2019-02-01	24	2021-03-01	24		
2012-12-01	27	2015-01-01	25	2017-02-01	23	2019-03-01	23	2021-04-01	27		
2013-01-01	25	2015-02-01	23	2017-03-01	24	2019-04-01	26	2021-05-01	29		
2013-02-01	24	2015-03-01	23	2017-04-01	25	2019-05-01	27	2021-06-01	28		
2013-03-01	23	2015-04-01	25	2017-05-01	27	2019-06-01	29	2021-07-01	27		
2013-04-01	24	2015-05-01	27	2017-06-01	29	2019-07-01	30	2021-08-01	27		
2013-05-01	27	2015-06-01	27	2017-07-01	27	2019-08-01	28	2021-09-01	26		
2013-06-01	27	2015-07-01	29	2017-08-01	27	2019-09-01	29	2021-10-01	28		
2013-07-01	27	2015-08-01	26	2017-09-01	28	2019-10-01	30	2021-11-01	28		
2013-08-01	27	2015-09-01	24	2017-10-01	27	2019-11-01	29	2021-12-01	26		
2013-09-01	26	2015-10-01	28	2017-11-01	28	2019-12-01	26	2022-01-01	24		
2013-10-01	28	2015-11-01	28	2017-12-01	26	2020-01-01	24	2022-02-01	23		
2013-11-01	27	2015-12-01	27	2018-01-01	24	2020-02-01	23	2022-03-01	24		
2013-12-01	26	2016-01-01	25	2018-02-01	23	2020-03-01	24	2022-04-01	27		
2014-01-01	24	2016-02-01	24	2018-03-01	24	2020-04-01	24	2022-05-01	29		

Warmness waves are meteorological actions that have installed a great deal of attention in current years, given the mortality related with them and distinctive the image of increases in their occurrence, period, and energy as a part of global weather change(Ponzi & Iwasaki, 2014). Heat wave is a commonplace particularly warm spell generated thru patience, which becomes a climate-associated natural danger entrapping particular vicinity. Heat waves called as uncommon periods of humid and warm and/or dry and warm conditions, which reign thru 3 to 5 consecutive days all through summertime. However, there is no prevalent definition of warmth wave's episodes(Hanif, 2017). Establish increases within the frequency and depth of heat wave events, together with the projected acceleration of these events global, have caused a fast enlargement in research at the fitness impacts of intense warmth(Rayner & O'Brien, 2001).

Climate alternate has ended in global warming; a standard fact this is influencing the decrease surroundings in addition to the oceans of the globe (Hussain et al. 2010). The weather parameters are ever converting and always growing a dynamic equilibrium. This makes the city making plans dynamic and forces them to update themselves and have a clear perception of the state of affairs in destiny. Lockley the in this new technology, researchers have state-of-the-art tools for

predicting forecasts for urban making plans and control. Karachi witnessed a warmth wave in June 2015 for the duration of the Muslim holy month of Ramadan. Average, citizens of Karachi were about 17 times as in all likelihood to die of a warmth-related reason of dying for June 2015(Guariglia et al., 2006). In the course of may additionally all Sindh and areas south eastern& Japanese Baluchistan paperwork a risk quarter of extreme warmness. In June, July, and August hot weather brings about an intense warmth index(Guariglia et al., 2006).

According to health experts, a deadly heat wave that struck Pakistan's Sindh region in June 2015 resulted in the deaths of more than 700 individuals. Within three days, Karachi saw the majority of the documented deaths, which were mostly caused by heat stroke and severe dehydration. The city experienced temperatures that exceeded 40 °C, and on June 22 the mercury reached 45 °C, just falling short of the city's all-time high of 48 °C on May 9, 1938(Gulick, 1963).

Due to the extreme heat, many Pakistani people have died in Karachi. Numerous studies have linked hot temperatures to rising sea levels and other extreme weather events that cause numerous injuries and even fatalities. Increased temperatures throughout time are associated with significant claims losses for the insurance sector (Appannagari, 2017).

In Karachi, the 2015 warmth wave was no longer close to record ranges. However, relative humidity (35% to 70%) combined resulting in maximum warmness indices. The combination of temperature and relative humidity is uncommon but can occur. This precipitated a human toll of around seven hundred deaths(Dash et al., 2007). The Asia-Pacific is the vicinity maximum at risk of worldwide climate exchange. It is far the world’s maximum populous place with the highest population density, settled along the long coastlines of the Indian and the Pacific oceans. Its sub-regions have various degrees of vulnerabilities. South Asia, which is the sector’s most populous sub-place with 1.7 billion humans, homes 1/2 of the sectors bad and is home to at least one.7 billion humans(ESCAP, 2015).

The highest temperature recorded in Karachi during the 2015 heat wave was 44.8°C on the city's heat index rating(Rajak & Chattopadhyay, 2020). However, on June 20, the day of the greatest heat wave, the heat index reached an exceptional 66°C

because of decreased wind speed and air pressure along with increasing humidity. The destitutions became even more severe when Karachi's power infrastructure proved unable to handle the increased load. As a result, water service was eventually delayed in impoverished and crowded areas since electricity was required to pump water to roof tops. The victims were often elderly persons (>50 years old), especially labourers who were followed by kids and ladies. Heat spasms, heat exhaustion, dehydration, and heatstroke were the main causes of mortality that were acknowledged by several health components(Tahir, 2017). More than 80,000 people were made worse by the heat wave and transported to the nearby hospitals for treatment or first assistance. The majority of them were released after receiving early care and preventive instruction, while the most dangerous patients were admitted for extensive treatment (Taylor, 2014).

Pakistan is experiencing such excessive climate situations each in summers and winters because of the lack of state-of-the-art weather prediction generation in Pakistan contributed to the casualties of the heat wave (Nergis et al., 2017).

The heat waves of 2015 in Pakistan were rare meteorological event. This anthropogenic suggestion is higher than for day-by-day measures of heat wave severity, with potential implications for human health and mortality due to their dependence on warmth wave period (Nergis et al., 2017)

Pakistan has a severe heat wave (temperatures as excessive as 40°C to 45°C) due to moisture ranging 40% to 50% hit southern Pakistan. Deaths changed into about greater than two thousand from dehydration and heat stroke mostly effected Sindh province and its capital town, Karachi(Nielsen et al., 2021).

According to a study serious (Oanh et al., 2006) risk has been identified as continuous, high temperature sideways with rising humidity for an extended length of time. For anyone involved in outdoor work or activities for even a short time, the high heat index values could pose serious health risks. The public health may be at considerable danger even though the heat index has remained high for a consistent, extended period of time. There were expected to be 1200 fatalities in Karachi in 2015 due to the heat wave. Karachi had one of the hottest temperatures in Pakistan's meteorological history in 1979 during this heat wave. Although nearly all of

Pakistan's districts in the 2015 heat wave experienced extremely high temperatures, including Larkana's 49 °C, Turbat's 49 °C, Sibbi's 49 °C, and the Southern parts of Punjab's 40 °C, many other factors, in addition to high temperatures, are to blame for Karachi's high death toll. Figure 2 displays the significant temperature histories for several regions of the nation from June 19 to June 22, 2015(Niazi, 2015).

2.7 Flood

Topographically Pakistan lies in 24-37 °N 62-75 °E inside the west. Precipitation fluctuates generally, contingent on rainstorm winds and the western aggravations. The precipitation does no longer have a particular recurrence or routineness. KPK (northern mountains)(Niazi, 2015) and Baluchistan procure have precipitation from December to spring. In any case, Punjab and Sindh gain 50-seventy-fivepercentage of precipitation throughout the rainstorm season(Salma et al., 2012).

Karachi lies among north scope 29°-51' and east longitude sixty seven°-04'. Geographically Karachi has sedimentary rocks with beginning in Kirthar and bar assortment, giving it loamy sandy and gravelly soils. Karachi is a piece of the semi-dry area of a; making its environment sparse with temperamental rainfalls.

Karachi observes storm drains ordinarily from June to September. The once-a-year normal precipitation for Karachi is 174.6 millimetres (1981-2010). The best yearly precipitation of 713 millimetres signed in 1967. The outrageous precipitation in a one day noted on the 27th of August 2020, any place 230 mm of rain recorded in the city. The city noted development in precipitation in 2003, 2006, 2007, 2009, 2010, 2017, and 2019 (Nazir & Lohano, 2022)

Quick populace progress are making Karachi city powerless to the impacts of garish floods. Extreme precipitation events have been drilled by the city on various examples influencing massive mischief to humanoid lives and stuck transportation and correspondence for different hours All through the Rainstorm time frame (July to September) the gamble of metropolitan flooding is exceptionally high(Bakhsh et al., 2011).

Malir Stream, having catchment locale of 1974 km2 is very wide. The catchment area being visiting the area, city can be powerless against occasional floods specifically in rural areas along the riverbanks. If there should be an occurrence of weighty precipitation, water stays for a drawn out period without even a trace of waste limit. The thickness of waterway changes from 200 m from upstream aspect to 1000m from the downstream feature in nearness of Jam Sadiq. Research has shown that immersion force at this scaffold is 2.89 m, which is like in rainstorm of 2007. The most extreme flood gathering profundity in view of August, 2007 precipitations in Malir waterway region changed into 4.82 m, flood amassing profundity in light of August, 1979 weighty shower in Malir Stream an area become 4.85 m (PAKISTAN, 2017)

Sindh experts in 1984 built banks to save you the 1977 flood calamity on every features of the Malir Stream starting from scaffold of the public expressway to the Gizri spring. The construction in wellbeing from situation like 1977(PAKISTAN, 2017). The pinnacle of the banks transformed into raised to cook for floor spill over of 240,000 cusecs keeping up with recent years' time frame. However, the exploration shows that during 100 years it can come to 409,000 cusecs. Lyari expressway has been fabricated keeping in considerations as dikes became coordinated. However, there are no methodologies of the city organization both made or is performed to shape watches close by various natural nalas the same Safora Nala, Gujr Nala, Budnai Nala and so forth Or on the other hand to keep their aides from land encroachers and grabbers(Akram & Hamid, 2015).

Karachi Storm 2020, newly rainstorm downpours of a startling check started floods in Pakistan includes in Karachi, in which both the amount and volume of land overwhelmed become a remarkable catastrophe. The town of Karachi obtained most noteworthy encroachment precipitation in among twenty fourth-27th of August in

which an incredible 230 mm of precipitation on a one day of August 27 noted. The records collective by utilizing country wide catastrophe the board Authority surveys 184 passing in downpour related occasions all through the Pakistan. Where 80 passing have been referenced in Sindh and 47 mortalities have been expressed in Karachi alone. These passing's had been because of sinking, electric shock and bombing rooftops. In generally speaking Karachi procured 604-mm of precipitation inside the long stretch of August in 89 years (Akram & Hamid, 2015).

Pakistan is at outrageous gamble to flooding inside the not so distant future as shown by the geospatial investigation and various towns in this way be emptied. The review outcomes gave that specific indications of relationship among clashes and weather conditions change are numerically on higher side.

A review directed by (Ahmed, 2016) on Karachi and saw that the greatest slanted regions in expressions of flood annihilation that became fake for a long time back length precipitation exercises are the lesser parts of Malir division, and urban areas of Gadap, Korangi and Gulberg. To diminish the impacts of floods in the town, advanced seepage contraption for rainstorm water float basics to be ensured close by the use of strategies to diminish the degree of floor flood like less impact improvement (Top).

An assessment of inconsistencies to look at precipitation inclinations for quite some time (1976 - 2005) for Pakistan, from 30 perspectives by means of the nation and finishing up a normal lower of one.18mm in precipitation in accordance with period, all through the Pakistan(Akram & Hamid, 2015).

A careful research on Karachi's weather conditions sorting out weather conditions trade through utilizing climatic records of fifty years found that the example is exceptionally particular for Karachi in contrast with Hyderabad and Badin showing dramatic blast of and decrease in yearly precipitation(Akram-Lodhi, 2008).

2.8 Ambient Air Quality of Karachi City

Climate change and air pollution are diligently connected. Climate is the further side of the similar that decreases the value of our Earth (al & et al;, 2016) Climate change, initiated by increasing discharges of GHG gases such as (NO_X), (SO_2), (CO_2) and Hydrogen, etc. from automobiles, power stations and manufacturing divisions will not simply special effects the environment and the ocean but then also will modify the Earth geology(Ali et al., 2018). Airborne contamination is one of the emerging environmental risks, with devastating and long-lasting environmental, health, and economic impacts on society. From the previous era, the Asian states have experienced extensive growing in urbanization and development together with automobiles and a rise in energy usage. Significant growth has happened in the forms and quantity of discharge bases of air contaminants in the constituency. The overall trend of industries in the country contributes more towards polluting the environment(Ali et al., 2018). Due to the spread of industrial zones in the rural area as well as in the far and near vicinity of cities, the problem of air pollution is penetrating the clean and healthy rural zones, thus degrading the environment(World Atlas, 2019). Historical records show that extreme fatalities such as drought and flooding, put strain on local substructure and institutes, with significant financial, societal, and environmental significances. Hence, there is a need to emphasize the mitigating impacts of such significant impact(Mustafa, 2011).

Increased particulate count numbers ($PM_{2.5}$, PM_{10}) were found in six Asian capitals (Bangkok, Beijing, Bandung, Chennai, Hanoi and Manila) with the aid of (Nazir & Lohano, 2022) inside the outline of the Asian local air contamination studies setup. The common $PM_{2.5}$ and PM_{10} concentrations were inside the assortment 44–168 and 54–262μg/m^3 inside the dry period, and 18–104 and 33–180 μg/m^3 within the moist period correspondingly

It observed transport Lahore was accountable for 23–26% of extra CO(Aziz & Bajwa, 2007). The Pakistan financial Survey record 2006–2007 said that Pakistan was distress from air quality deterioration because of populace increase, absenteeism of

public run commute facility and exponential growth in private cars. The World Bank report (Wignall, 2001) recognized particulate pollutants as a severe environmental health challenge and actionable for 22,000 early demises amongst adults and 700 deceases amongst children, with the whole yearly fitness burden because of PM being 1% of the gross home invention.

Karachi has a very greater and diverse economy. It is the industrial hub of a wide range of industries in different parts of the metropolitan such as Korangi Industrial Estate, Sindh Industrial & Trading Estate (SITE), North Karachi Industrial Estate, FB Area, Port Qasim, etc.(Idress et al., 2021).

Work and analysis of (Ilyas et al., 2019) to define the responsiveness of ambient air quality in terms of air born particulate be counted (PM_{10}) at 10 one-of-a-kind tracking locations along the busy roads of Karachi metropolis. Concentrations of particulate are counted were used to calculate the consequences in terms of the Air first-class Index (AQI). At each region, the observations were conducted for a period of 08 hours every month in the course of the year 2013 to 2017. Consequences alongside the selected places display that at a maximum of the locations havevery terrible to dangerous AQI class regarding thePM_{10} concentratio n which exceeds the permissible limits as designated WHO(Malik et al., 2020). This excessive level of pollution is very harmful to human fitness to the residents.

Parekh et al. (2001) stated TSP in Islamabad and Karachi from 10 December (1998) to 8 January (1999). They estimate average everyday TSP values at Karachi in between 627–928μg/m^3, whereas those at Islamabad remained among 428 and 998μg/m^3(Mahar & Zaigham, 2010).

The PM_{10}average levels stately with a portable monitoring station at the Korangi Industrial Area and SITE (Karachi) were 176.5 and 147.2μg/m^3, correspondingly. During 7 days, the hourly average PM_{10} value at Port Qasim in Karachi for November was 123.49μg/m^3(Mahar & Zaigham, 2010).

Study of the effects of a year lengthy standard air quality observations with the aid of the Pakistan space and upper ecosystem studies (SUPARCO) in the course of 2003–2004. The monitoring had been performed by using two mobile labs at C programming language of 15 min for forty-eighth (48) at every location(Colbeck et

al., 2010). Following TSP (1 h maximum), in Lahore, the readings become 996μg/m^3, whilst the values in different metropolises were nonetheless increased: Peshawar (530μg/m^3), Quetta (778μg/m^3), Islamabad (490μg/m^3), Rawalpindi (500μg/m^3) and Karachi (410μg/m^3). Nevertheless, these towns showed a barely extraordinary configuration for PM_{10} (1 h most) with values lowering from Peshawar (350μg/m^3), Lahore (368μg/m^3), Quetta (331μg/m^3), Islamabad (280μg/m^3), Karachi (302μg/m^3) to Rawalpindi (276μg/m^3)(Colbeck et al., 2010).

The disastrous impact of climate change is already being felt around the globe. Climate change is affected by growing discharges of greenhouse gases. Pakistan's metropolitan air pollution is amongst the utmost severe in the world and it bases main reparations on economic activities and affects human health. This study has been deliberate for the analysis of ambient air value in different Karachi areas. The surveys have been done based on seasonal variation i.e., pre and post-monsoon from four industrial zones viz. S.I.T.E area, North Karachi industrial area, Korangi industrial area, and Landhi industrial area in the year 2019. These zones are comprised of the industrial, residential, and commercial sectors, so heavy traffic and dense populations affect these zones. In this study HAZ-SCANNER (HIM-6000) apparatus was used for data collection of Ambient air contaminants like nitrogen oxides (NOx), carbon monoxide (CO), and sulphur dioxide (SO_2), particulate matters (TSPM, PM_{10}, and $PM_{2.5}$). For spatial-temporal analysis of ambient air quality GIS interpolation (IDW) technique has been used. It is observed that in post-monsoon, the intensity of particulate matters (TSPM, PM_{10}& $PM_{2.5}$), CO, and NO_2 values in sampling sites are rarer to modest than the standards of pre-monsoon due to the seasonal monsoon effects(Colbeck et al., 2010). While North Karachi have least risk because small number of the scale of manufacturing units present. The PM_{10}& $PM_{2.5}$ levels average about 2-3 fold more than the SEPA values. High levels of ambient air contaminants source of severe healthiness harms and chronic diseases on human health. Thus, the application of rules and regulations regarding ambient air pollutants should be more active.

The Intergovernmental Panel on Climate Change (IPCC) notes that since the industrial revolution in the middle of the 19th century, the global average surface temperature has increased by roughly 1.0°C and is projected to continue to climb by

1.10 °C per year from now until the end of the 21st century(Urquiza et al., 2021). Due to its status as a developing nation, Pakistan is particularly affected month to month by the negative effects of climate change, including rising temperatures, an extended monsoon, the melting of glaciers in the Himalayas and an increase in the frequency and severity of extreme weather and natural occurrences. Future changes in Karachi's local climatic activities are anticipated due to the current increase in Earth's surface temperature caused by climate exchange(Urquiza et al., 2021).

Monsoon rains hit Karachi from July monthly September, and there has been no vital variant in the timeline of the Karachi monsoon season over the past 25 years. In step with statistics collected with the resource of the Pakistan Meteorological branch from 1985 month-to-month 2014, Karachi's commonplace annual rainfall degrees from gas emissions lessen the length of Asian monsoons expertise boom the severity of rainfall with the rest of the year having extended dry intervals. Consequently, miles glaring weather exchange is worsening floods, deficiencies and wildfires in Karachi(Safdar et al., 2019).

Indoor air pollutants bases contain of biomass fuels, coal, and kerosene which can be all charred for need for human. Pollutants are the rising for roughness and loss of life the existence of particulate trust (soot) within the kids' airway in Pakistan. In addition, such air pollution is also in all likelihood to make a contribution month-to-month the superiority of non-communicable sicknesses particularly stroke, ischemic coronary heart disease, and continual obstructive pulmonary disorder. Ambient (out-door) pollution assets are especially from increased fossil gas consumption, site monthly emissions, electricity plant generation, and industrial emissions(Safdar et al., 2019).

Heat wave effects: The temperature average of Karachi is 25.9 °C (78.6°F) and rainfall is round 194 mm (7.6 inch) in line within moon seasons. A growth of 0.25 °C temperature monthly recorded over the last 59 years. In addition, Karachi's moistness levels from 58% in December (driest month) 80.5% in August (wettest month)(Safdar et al., 2019). In the summer season heat wave that overcome Karachi in June 2015, the death surpassed more than 1200 in a span of 10 days, proving that heat waves have dire consequences on the disease and death of the Karachi population. First-rate temperature recorded to 44.8 °C and the cumulative of severe

humidity and excessive temperature became the using component of this disastrous event. Heat index climbed monthly 66°C for the duration of this hot temperature wave and at the aspect of immoderate humidity, brought about dehydration and heat stroke. A phenomenon occurs in hot weather while body tries to regulate its temperature via sweating; know-how, increased humidity ranges save you and slow down moisture evaporation, consequently delaying cooling and thermoregulation and increasing the hazard of excessive heat related infection.

Droughts in the arid southern and essential regions of Pakistan, high and frequently unpredictable rainfall styles from February to March can regulate lake and watercourse. From 1999-2002, Pakistan experienced a country wide drought that located the impairment/weaknesses of the Indus River Basin irrigation, the whole movements of water in most important rivers dropped form 34% under the norm. Human beings confronted extreme water shortages and fundamental crop yields declined by 10%. At the same time as future rainfall predictions continue varying, it's far expected that rainfall extremes turns more noticeable, changing the seasonal distribution of rainfall. Coupled with growing temperatures, this is expected growth evaporation and reduces water accessibility in drought-inclined areas.

Sea-level upward thrust the low-lying coastal areas of Pakistan, which encompass the city of Karachi, are at enormous hazard from projected sea-diploma upward push. Even below conservative eventualities, projections endorse a 40cm upward push by the Cyclones and hurricane surges the lowland plains of Sindh and Baluchistan, which encompass the town regions of Karachi prone the effects of cyclones. In 2007, storm surges Cyclone Yemyin had good sized impacts on lives and belonging(Safdar et al., 2019)s.

Pakistan’s coast spreads over 990 km and is home monthly the naturally numerous and valuable Indus Delta and mangrove forests(Elahi et al., 2015). The mangrove ecologies along the coast are previously going through extreme affects from prolonged sediment masses, reduced glowing water entries, a rising range of aggressive species, clear-felling of forests, and pollution from human sports. Sea-level upward push and delta flooding are already significantly impacting the coastal region, leading monthly water shortages, declining belongings values, loss of priceless archeological websites, in water logging is likewise a extreme project in lots of low-

mendacity areas of Sindh. Coastal erosion and monsoon waves are previously intimidating and farms placed alongside the west Makran coast. Beaches are being weather-beaten away and precious mangroves lack legal protection. at the same time as protective infrastructure, including port walls in city areas in Pasni and pitching in Gadni have already been constructed, a whole and geologically express vulnerability evaluation is essential with a purpose develop a coordinated and complete coastal conservation plan. Despite the fact that extreme tropical cyclones are noticeably unusual within the Arabian Sea and their frequency has been in decline due 970, the dynamic, and specifically the depth, alternate significantly with rising sea floor temperatures, resulting in excessive damages thru large typhoon surges. A growth in small cyclonic interest has added intense rainfall that previously reasons intense flooding in low-mendacity regions.

The developing period in place of rice and its production remain too predicted monthly lower now entirely areas of Pakistan(Elahi et al., 2015). 2011 look at by way of way of Ali (Zafar & Zaidi, 2019)projected a 15–18% decay in rice production by the usage of 2080. Farm animals manufacturing is likewise anticipated be adversely better temperatures that could bring about lesser milk and meat production, reduced cattle replica, and decreased fodder production (Bhandari, 2022).

priority measures diagnosed thru the authorities monthly cope with dangers consist of figuring out rain-fed agricultural regions drought and heat stress; setting up a hazard control device for crop manufacturing; improving neighborhood veterinary centers; growing agriculturalists' and special investors' focus of green land-dwelling use techniques, water conservation strategies, and incorporated cropping strategies; consolidation extension offerings; solidification agricultural research in Khyber Pakhtunkhwa Province; and growing lack and temperature accepting crop types (Bhandari, 2022).

The strength deficiencies are also a limitation on Pakistan's modern economic system weather alternate should compound this situation through growing strength call for (e.g., for air con and water pumps) and decreasing supply, thinking about unreliable water additives should lessen hydropower manufacturing and feature an effect on thermal flowers' cooling centers. Energy infrastructure can also be placed at more risk with the useful resource of severe activities consisting of cyclones and

torrents (making plans instruction,), mainly in low-mendacity coastline areas (Correa et al., 2011). In reaction, the GOP has declared plans monthly rise the supply of central and allotted sun strength, on-shore massive-scale wind electricity, geothermal strength, and big besides small hydroelectric control . Some of those efforts to bolster Pakistan's strength safety may want month-to-month offer variant co-advantages, as should monthly efforts month-to-month enhance monthly the power performance of homes and implement monthly power conservation law, there's a hazard that the GOP's push monthly expand eight Pakistan Agricultural studies Council, personal communication.

Pakistan's coastline areas, in conjunction with the municipality of Karachi, also are specifically inclined their widespread populations and concentrations of financial belongings (e.g., power, production, farming, fisheries). Sea level rise, typhoon streams, monsoon waves, and storm hobby are probable keep corrode coastal areas, increasing salt water similarly inland, and impairment infrastructure. A thorough and geologically clear susceptibility calculation of Pakistan's coastal areas remains monthly be undertaken specially willing populations were diagnosed as the ones living in coastal groups, minor farmers; particularly the ones depending on rain-fed agriculture—and those presently alive in scarcity greater usually(Cooper, 2000).

Pakistan positions most of international locations maximum effects of climate change, scoring 46.8 at the Notre Dame worldwide model Index (ND-benefit) its excessive vulnerability and occasional readiness enforce model movements. The index specially Pakistan's charge of lake removal and the situation constrained barrier garage capability capita, alongside restricted numbers of scientific group of workers and terrible get proper of entry advanced sanitation abilities, as key causative its susceptibility. By recognize readiness, impairments diagnosed protected restricted obtainability and usage of statistics and communications era substructure, small enrolment in tertiary training, and partial caution signs and symptom of innovation as measured through way of the style of patent applications(Correa et al., 2011).

International Union for the Conservation of Nature(IUCN) takes location via and big on minor farms, which account for 90% of all farms (Ali et al., 2017). 81% of farms in Pakistan are considerably a lesser amount of than five hectares in length. Development inside the vicinity has handiest been 3.3% over the last uptake of

present farming techniques, confined funding in needed infrastructure, slow generation invention, pest and cattle sickness troubles, and restrained get right of entry to monthly credit score for manufacturing and handling(Armstrong et al., 2014). Land ruin is specific task, by soil corrosion distressing 18 million hectares, salinization affecting over 5 million hectares, and waterlogging affecting a similarly 2 million hectares(Ball & Haynes, 2013).

Pakistan's vulnerable financial universal overall performance is in detail linked its traumatic conditions in accomplishing strong political governance(Wilcoxen et al., 2015). Systematic corruption is likewise extraordinary hassle, with the federal authorities usually ranked a number of the maximum fraudulent on worldwide guides(Diamond, 2015)(Kovach, 2015).

Environmental filth in Pakistan can be visible inside the level at which it's far losing its forest cowl, growing an extra supply of defenselessness weather trade. The last survey finished thru the food and Agriculture commercial enterprise corporation in 2007, natural forests included 434 hundred km2 of Pakistan, or most effective 4.eight% of America of a (Parry, 2016). Forested lands are predicted remain decreasing at a ratio of among 0.2 and 0.4% consistent with year(Khan, 2011). Different ecological alarms encompass waterlogging of the topsoil in the low-mendacity zones of Sindh Province and dilapidation of coastline mangroves(Ghumman & Horney, 2016). These issues are compounded by the use of prone functionality put in force modern-day surroundings-related hints(Khan et al., 2015) World financial group must anticipated that ecological humiliation and useful source harm expenses the Pakistan economy near 365 billion Pakistani rupees (about CA$ 4.5 million) in keeping with year, about 6% of GDP, and that the poor are excessively stuck with the aid of these charges(Ahmad et al., 2021)). These current conditions, which restriction Pakistan's adaptive capability and growth its sensitivity monthly climate trade, depart, especially vulnerable this worldwide process.

National-degree improvement policy context version movement in Pakistan is basically customary by way of way of overarching country wide-diploma coverage binders. (Bhutto et al., 2019) is the countrywide growth imaginative and prescient framed in 2014 with the useful resource of the brand novel federal government. This file sets onwards a idea of Pakistan flattering a center-earnings via 2025 (pondered in

a constant with capita GDP growth from US$1,300 monthly US$4,2 hundred), and existence the numerous 10 biggest frugalities in the worldwide thru using 2047. This idea is be finished via moves below seven pillars 9 and aided through using 5 permitting. Pakistan 2025 identifies weather alternate as issue vicinity for movement, identifying it as a compounding venture; specifically with detail its doubtlessly terrible inferences (at the side of water beneficial resource reduction) for meeting the meals protection and desires of a rising populace. Underneath Pakistan 2025's support targeted on reaching H_2O, electricity, and foodstuff protection, the file moreover classifies main desires on behalf of responding the effects of weather transformation, especially: "layout water, food and strength safety policies and plans with particular connection with the profound stressful conditions posed by means of weather trade. "To endorse long-term sustainability, preservation and security of herbal sources" (Singh & Singh, 2012)

Authorities similarly commit violently discovering rising possibilities for funding mitigation and version thru the green weather Fund and ability-building and institutional-strengthening guide furnished below the United nations Framework agreement on weather alternate (UNFCCC) (Simpson et al., 2021).

The second critical main country wide policy manipulating variation act in Pakistan is the 18th modification monthly the charter surpassed with the aid of the country wide gathering of Pakistan in 2010. The said goal of this procedure is beautify the distribution of facilities, inclusive of fitness, schooling, water, and power, horrific and demoted populations of Pakistan(Shahid et al., 2020). A number of the modifications passed by method of the revision are delegation of federal authority's accountability and an establishment of provincial expert. For itself, accountabilities of what was then the Ministry of Environment, with environment alternate, had been devolved scheduled the provinces in 2011. Efficaciously, this has removed main accountability for the improvement and application of version strategies regularly the provinces. This change delivers Pakistan's provinces with more ability monthly adapt edition tactics and act so as to the higher statement their one in all a type danger and priorities.

Sufficient management, resources, and ability need a regularized area for this capability be realized. As attractively, in spite of the reality that delegation has gave

more charge subnational governments, federal establishments and hints maintain the influence version making plans and motion. The federal government additionally rests accountable for Pakistan's meeting in global approaches, inclusive of these of the UNFCCC.

2.8.1 Country Wide-Level Weather Policy Context

Pakistan has indulged climate change policy since 2008, and the first concerted steps within the route of the improvement of centered weather change policies while the planning fee established the assignment stress on climate exchange. A goal of the assignment pressure has formulated a "climate exchange insurance that might help the government in pursuing the paramount aim of sustained financial increase through using effectively addressing the worrying situations model by using the chance of climate alternate"(Khan, 2011). It changed into also regularly classify and mark pointers regarding procedures that could assist make certain security of the united states of America's water, power and food sources; improve gift official capabilities; and decorate cognizance and of climate conversion(Khan, 2011). The challenge strain brought its concluding file in February 2010.

Constructing on the content material of the project stress's report, the Govt. of IR Pakistan initiated improvement of a country wide nationwide climate change strategy (NCCP). finished in 2012, then formally threw in February 2013, the aim of the NCCP is regularly "make sure that weather trade is mainstreamed inside the carefully and informally susceptible the economic system and Pakistan weather flexibility development" (Cangany, 2012)version is the main awareness of the policy, with a solid emphasis on confirming the united states of America destiny water safety, food protection, and energy protection. It also objectives monthly promote seasoned-terrible and gender model measures; addition of weather alternate policy with other countrywide guidelines; inter-ministerial coordination; climate popularity; and get admission to prearranged national and international potentials, especially investment opportunities(Cangany, 2012). Excessive-degree coverage measuring regular

reduction of the vulnerability of the subsequent seduction on an average diagnosed: water property, health, cattle farming, agriculture, biodiversity, and forestry specific susceptible ecosystems (rangelands, grasslands, arid and hyper-arid regions, seaside and aquatic ecosystems, wetlands and mountain areas). It is noted that the above areas also identify coverage measures regular deal with greater move-slicing regions of need, mainly disaster preparedness, poverty, gender, potential constructing, era switch, and global cooperation(Cangany, 2012).

To rise the further images of the nationwide climate change policy in 2013 the federal government launched this agenda for Application of climatic changes insurance. This scheduled framework building on the national climate change policy interests to regularized and provide an "actual institutional framework on scheduled the normal climate alternative alarms and regularized the standard provincial wide planning and regularized the extended the climate conditions and suitable improvement with easy units of characters and obligations on the centralized and local tiers"(Zacharias et al., 2013). The number one interest is to stays climatic version. This has also been the concerned areas identified in the national climate change policy, the framework tool is a unique target to regularized on basis of modern techniques for engaging in certain objectives, the time-frame concluded in that it may be applied regularly and the establishments of various tasked with implementation and goals were identified for each area of priorities.

The national climate policy was laid those strategies for a novel official structure for coping with changing climate of Pakistan, collectively with status quo of a rustic huge climate change charges can be regularly coordinate country wide and worldwide weather change anticipation activities. This has also required federal govt. as well as provincials' govt. to show the climate trade coverage by committees of experts regularly facilitate effective implementation and monitor improvement at every stage of provincial jurisdiction. This is also equally established order of weather alternate cells in ministries levels at the provincial and national tiers as well as for a Pakistan climate change funds regular finance projects (Cangany, 2012). The fictional framework should also additionally highlight the regular increase the institutional functionality at the provincial and federal levels on regularly put deliberate weather change actions, alongside securing funding. Specifically, it should also note that the

need to bolster the capability of the formerly climate change division-CCD(Zacharias et al., 2013), was not any strategies for applying the official changes designated inside the national climate change policy are covered the inside of the framework, nor have they been initiated in workout. Eleven inside the Framework, priority actions are monthly be accomplished interior years, briefly actions terms are within the 5 years' plan, medium-term period action plan within 10 years' time and long term actions plan is extended period of time (Zacharias et al., 2013)).

The national climate change strategy and the shape of the agenda constructing the blocks of institution upon which the federal government expects emerging a proper countrywide edition plan. This has also probable that the strategy would be cope with contemporary slits in the structure with appreciate regularly identification of quantifiable objectives and needed monetary sources. It is regularized additionally be said that neither the national climate change policy nor the framework in particular perceive the required regularly expand a whole device for continuous examining and comparing version improvement. The phases closer to regularized the improvement of any such areas do not longer appear monthly had been initiated with the resource of the federal authorities. Furthermore, the national climate change policy does now not seem regularized virtually deal the climate change as an extra stressor on growth sports and as a result deal its incremental effect across a number of multi integrated way (Sud et al., 2015).

2.8.2 Institutional Form for Climate Governance

Institutional form reflected the govt. of Pakistan irregularity in economically and party-politician consistency, institutional preparations for climate revolution manipulation has regularly been changed during last 20 year of long term. This can be tested by using modifications at the federal ministerial levels during the preparation of framework. Other obligation for climate change control at the commencement of related department of the environment, information subsequent the delegation of

power in 2011 the accountability was to moved provinces first time in Pakistan and the ministry of development and plans after which meet the ministry of interior to manage the natural and manmade catastrophe & hazards managing (Podder et al., 2015)). In 2012, the ministry of climate change become installed and it was assigned an assignment to comply to coordinate the weather change planning was to different related ministries (e.g., development and infrastructure planning, water and electricity, fitness, meals safety, and Finance) and organizations, in addition to serving as Pakistan's focal aspect regularly to the united nation framework on climate change cooperation.

After the regime shift of political power in 2013, the ministry of climate change has regularized the climate change division formed the board of Secretariat and commemorate the annual charge variety reduce thru over sixty % (Podder et al., 2015)) responding month wise weather change. The selection of board of secretariat became retreated in the month of January 2015, whilst the authorities newly established the ministry of climate change with appointment of federal minister to run the ministry wise versa and the ministry of finance and finance division approved the additional expenditure to cater the MOCC. The newly established ministry is than to operate and facilitate the coordination between departments of federal government and rise access regularly to enhanced0the investment from international community (Podder et al., 2015). The another mandate is to coordination among cross-government facilitation by means of using the Committees of experts on weather change in the country wide meetings that was first initiative taken in year 2011. The modern sixteen-individual committee formation was initiated in 2011 which has four members included technocrats since four party-political(Azizullah et al., 2011).

Analysis studies and projects on environment and weather variation in Pakistan is also sustained by many ways, i.e., number of federal charted organizations and research institutes while accreditation of the Pakistan Meteorological Department and branches for the world wide variation impact research Centre. Research institution were first collaborated by the federal government in year 2002, the worldwide exchange impact research centers become approved the expert and the recognition as an autonomous body of climate change studies center in the month of March 2013. The centers undertaken scientific research and enhanced the corporation

to build the capacity building and capability to monitor the climate change biophysical impacts. Expert of specific federal groups and research institutes encompass the PCWR-Pakistan Council for Water Research and the climate change, trade power and water assets institute, the PCWR is integral component of PARC-Pakistan Agriculture Research Council (Azizullah et al., 2011). The PARC is likewise dynamically involved in climate studies and activity related to changes occurred in climate. The other federal govt. committees and groups play a pivotal role in assistance of these institution to making plans and action encompass the making plans fee, the Water and energy development Authority, the Pakistan Environmental safety commercial enterprise, and the countrywide Institute of Oceanography.

Countrywide moment on climate change has been incorporated right on a smaller scale that is national policies, together with the local environmental guaranties, the local approach of sustainability gaining technique, the country wide catastrophic management coverage, the draft of local agriculture and food security and protection insurance, and on a regular scaling of the countrywide utilization of water coverage and country wide vegetative coverage. It was also indicated that the formation of desk 5, that the assessment expertise would precisely ministries would be cognizant about the need of frequent changes required to incorporated regularly in climate changes issues in recommendations and plans contemporary knowledge that progress toward this intention is presently restricted. Distinctly few regulations have recognized specific movements for decreasing the climatic changes and risk related to climate, and neither of those reviewed have set goals of that movements analyzing the regulations that extra intently in relations of their references regularly updated and coverage movements in guide model paradigm for local national environmental coverage in 2005 consists of multi segment for the climate changes ozone, which can be have the ability to advancement with the assistance of the federal government to the national climate change protection and movement plan (Azizullah et al., 2011). A re-addressing protection reflected the outcome of the amendment in 2012 that is called the 18th amendment has not been expertise prepared.

In the year 2012, Pakistan issued its countrywide ecological development method(Khan et al., 2015), that are absorbed and interest are to regularized the outcomes of climate alternate for country development in area of climate change

policy framework. In the country slogans to improve the climate change, that is needed to “mainstreaming of climate trade in monthly country wide economically crucial and susceptible areas of the monetary system” (Khan et al., 2015). This technique was to opted additional tips for enhancement i.e., probably taken the potential of the united states of America to regularized and cope with weather alternate, collectively with task extraordinary moves as a manner monthly facilitate model on the local degree; ensuring water, electricity and meals safety in a converting climate with the aid of way of revisiting and imposing appropriate measures in specific time scale; and minimizing disaster hazards by incorporating such as climate proofing to current infrastructure. This technique further required the adoption of viable land employed practices, coordination of inter-ministerial commitments and building governance potential at the provincial and national levels, endorsing the research collaboration and cooperation of sharing warning structures, and developing robust extensive climate change endowment, particular exchanges regularly to fulfillment of those visions aren't still identified (Khan et al., 2015). United States of America has also been devised the policy framework back in 2012 formulated disaster risk through climate change. The targets was to creating an integrated national policy which can ability monthly discover and information to manage vulnerability and hazard developments along with ability weather trade impact” and promoting improvement devising that the considerable planning and addresses disaster dangers along environment and climate changes concerns”. The information can subsequently addition of regularized the development of blanketed risk, damage and loss record vulnerability manual and risk threat observing, and fortify climate change centered studies on glaciers and ice caps (Parry, 2016)

In 2013, the federal authorities of country also launched a current nationwide farming and foodstuff security authority(Khalid et al., 2015), the goals of the agriculture and food security is include making sure potential changes and flexibly adapt variation in climate change and be resilient sufficient timely brief get over sudden changes and emergencies (Khalid et al., 2015). The activities of timely weather-smart farming are stated. The draft rule additionally requires the introduction of exceptional country wide leading programs which dealt timely with the vulnerability of flood-prone and dry region may be included the coastal areas of the

United States of America, an application explicitly centered on variation of climate change (Khalid et al., 2015).

It is also recognize that the timely water shortage and the local utilization of water as well as security of 2009 without a doubt states that “due attention could be given the negative effects of weather change in making plans and establishment of framework of water consumption and supply structures”. The report of country wide water storage and utilization and changed pattern conference organized back in the year 2005, the information of climate alternate was no longer incorporated in time scale documents(Parry, 2016). The authorities has also been dedicated in Pakistan for the year 2025 to timely addressing the united states of America need for a complete water policy(Khalid et al., 2015). The agriculture and jungle land area insurance in 2010 were the focuses more regularly than now i.e., on priority function for country’s woodland was to timely performance an exquisite feature in carbon deposition as well as sequestration thru afforestation sports, understanding ever knowledge additionally requires forestry training and for research institutions month-to-month boom ability month-to-month deal with weather change influences(Abbas, 2010). Weather trade mitigation and version aren't addressed in Pakistan’s country wide power policy 2013.

2.8.3 Regional Guidelines

Implementation of Pakistan’s national climate change policy is anticipated in huge element take area at the provinces coping to the federal government presenting the cooperation and aid assistantship(Abbas, 2010). The policy was clearly demands for entirely applicable federal, provincial ministries and businesses on trial by teri-monthly, and local stages monthly increase plans and applications guide to proper implementation(Parry, 2016). Thus far, know-how, development of weather-associated insurance on the subnational level has in big component now not improved.

Back in the year of 2014-15, the authorities has approved to developed software program for identification of growing information and attention of climate change as surroundings-associated intention, and to getting attention climate trade and biodiversity protection was to consider one of its forestry-related goals of Punjab Province The classified report of the Punjab government sought months wise prepared functionality schedule interact in the smooth improvement mechanism, collectively with clean plans devised that the environment variation mobile in its Environmental protection agency i.e., Punjab environmental protection board(German et al., 2022). The province of Sindh, the forest unit branch, atmosphere and natural global has covered of a study on the impacts of weather trade, along with rains and floods in the consecutive year of 2010 and 2011, in its yearly growth agenda. Note with standing the commitments, neither Sindh nor Punjab govt. has been taken concrete steps towards the resilient resources and the compliance of climate change variation actions the report of worldwide Wild Fund for Nature Pakistan(Urooj & Jabeen, 2015). Climate change actions and tasks of the Baluchistan governments and the Khyber Pakhtunkhwa govt. have no longer been identified.

The action of federal and provincial governments is slow on the efforts of climate change (Urooj & Jabeen, 2015). As method of addressing the issue of climate change while some other improvement issues an effective addressed by country provincial authorities to augment extra ability building institutional improvement need month monthly take location (Urooj & Jabeen, 2015). Present adaptation plan for development is also need to revise and re-addressed accordingly the requirements putting at global level. The instance of continuing efforts putting on global scale by the country of the world deal with this essential is the climate control for real version and resilience assignment being applied with the useful resource of management for surroundings and development (LEAD) Pakistan in the provinces of Sindh and Punjab, that should be operating and expand nearby version plans of activities in twelve (12) districts of country(Volandes et al., 2013).

2.8.4 Present and Deliberate Variant Program Tasks

The schedule framework of capital expenditures thru the national and govt. of provinces supported by the worldwide network, is needed monthly obtain the set priorities identified within the united states of America numerous plan and policies. The current evidence of reasonably uncertain style of devoted variety suites with responsibilities will below manner, specifically to evaluating month-to-month one-of-a-kind South Asian international places(McManus, 2012).

2.8.5 Version Responsibilities and Programs

The research targeted on initiatives and applications that precisely goal month-to-month manual weather change version, as meditated in their discover, dreams assertion, and/or goal declaration many of the projects beneath manner in Pakistan retain monthly cognizance on project studies month-to-month apprehend the united states vulnerability month-to-month the effects of climate alternate. Development of appropriate governance systems and capacity building for the handling climate trade are also great focuses. There are some initiatives to be kicked without delay to involve in supporting the proper execution of priority type of actions.

The concern reflecting and growing constant with per capita water shortage during the frowning population and the functional effect of climate change on the aquatic properties predicted for future. The majority of the actions and tasks identified has robust cognizance on potable and freshwater and watershed control. Particularly, the country is involved in numerous huge nearby tasks seeking the potential effects of

climate trade and water assets deposited in the ranges of Hindu Kush and Himalayan mountain, midst of those are tasks being executed thru the worldwide studies for incorporated mountain growth (Liu & Rasul, 2007)): the range of Himalayan weather change model programme, in which a sturdy highlighting on information the uncertainties monthly the influence of weather change at the water assets of the essential river basins of the Hindu Kush and Himalayan location, and agricultural Livelihoods and weather trade within the Himalayas project, which pursues month-to-month boom the flexibility of bad and inclined mountain groups.12 likewise, the Himalayan version, Water and Flexibility assignment being carried out as a part of the (Harvey et al., 2017) software associations exploration and directing of community-month-to-monthly monthly activities monthly help make the adaptive potential of horrific populations dwelling in the river-basins served by means of the usage of the Hindu Kush–Himalayan mountains, which includes the Indus Basin. In adding to these local projects, the GOP and the version Fund are co-financing the lowering risks and Susceptibilities from Glacial Lake Eruption Floods in Northern Pakistan challenge being executed thru the UNDP. It monthly needs a robust attention on erection the capacity of federal and nearby government establishments and neighborhood corporations, similarly month-to-month imposing pilot community-stage sports, as a manner month-to-month hazard mapping, early-caution systems, and catastrophe making plans. In association with the UNDP, Pakistan has acquiesced a entreaty monthly the inexperienced climate Fund monthly finance a 2d phase of this task (García, 2017). Further month-to-month the ones projects, in January 2016, ICIMOD introduced investment for the farming River, electricity and vulnerability manage within the top Indus Basin for stepped forward Livelihood undertaking, the application of a good way month monthly be led thru the WWF. Different national companions are the Pakistan Council of studies in Water property, Karakoram worldwide college, and the Gilgit Baltistan disaster control Authority. Enchanting location in top Hunza, Gilgit Baltistan, the assignment pursues month-to-month enhance monthly agrarian water controlling and decrease the susceptibility of group's month-to-month herbal dangers (García, 2017)

A particular variety of large plans in Pakistan focus on refining flexibility inside the rapidly increasing urban areas. Distinguished amongst those creativities is the handling weather danger for city terrible assignment, a multi-million-dollar

regional initiative carried out with the useful resource of the Rockefeller basis. It is far running in 25 medium-considerable month-to-month in six Asian nations, which encompass in Pakistan, to strengthen capability monthly preserve in mind climate alternate dangers in making plans techniques. It in particular makes a specialty of new reserves in bodily infrastructure, which incorporates flood safety and wastewater systems. A greater centered inventiveness is the Mainstreaming climate change model thru Water useful reserve organization in leather-based business vicinity improvement undertaking being applied in Sialkot Region of Punjab State. running precisely by the area's big leather company, the assignment also pastimes month-to-month weather exchange variant in month-to-month town development making plans while demonstrating technology that beautify water remedy and conservation. The ones tasks highpoint the position of enhancing capability internal government and organization to evolve monthly the expected impacts of climate trade on Pakistan's large monthly. Endorsing a more strong agriculture part become either the focal point or a crucial detail of the most important variety of tasks diagnosed thru evaluate, and the focus of maximum of the tasks being applied solely inside the limitations of Pakistan. The general public of these tasks, even though, have a strong studies reputation; three are in reality existence applied beneath an umbrella program financed by means of using IDRC. Significantly an awful lot much less interest is being given month-to-month constructing the ability of farmers to evolve monthly the effects of climate alternate thru the adoption of weather-smart farming applies. An exclusion month-to-month this statement is the these days released Sindh Irrigated Agriculture productiveness Improvement challenge with its sturdy recognition on substructure reserves intended month-to-month irrigation water manage in slight of the growing consistent with capita shortage of water within Pakistan. Nothing of the liabilities recognized through interest month-to-month the wishes of these whose livings be contingent in standard on cattle and rangelands control.

Catastrophe risk management emerges as a difficulty goal of some of tasks, together with the aforementioned decreasing dangers and Susceptibilities from Glacial Lake Outburst Floods in Northern Pakistan project(Richardson & Quincey, 2009). Capability in this vicinity is likewise being made inside the country wide tragedy running Authority via the catastrophe risk coverage for inclined organizations in Pakistan assignment. It is helping monthly policy an assurance fund and expands a

coverage technique month-to-month monitor the formation and operation of this fund. Further to those discrete variation tasks, some of other initiatives are underneath manner in Pakistan month-to-month expand its early-caution systems and tragedy risk managing capabilities, especially in light of the outcomes of the 2010 great-flood. amongst those initiatives are the UN's catastrophe danger management guide mission(Clarke, 1999) and determinations to fortify Baluchistan's Provincial catastrophe manipulate Authority with financing from the Khyber Pakhtunkhwa, Federally Administered Tribal regions and Baluchistan Multi-Donor be given as authentic with Fund administered through month-to-month financial institution. at the same time as increasing resilience monthly weather trade might not be especially said as an objective of these projects, they might be predictable month-to-month create an effective influence monthly this aim to number of gaps in variant programming were additionally recognized via this assessment. From a geographic attitude, no matter the fact that Pakistan's coastal place is month-to-month various weather dangers and the net web page of awesome monetary hobby and important substructure, exact restrained attention has been given monthly promoting version efforts on this region. Further, few model tasks month-to-month targeting Pakistan's arid and hyper-arid areas, that are maximum of the maximum prone areas of the united states of America inner its Framework for enforcing the NCCP, for example, the authorities recognizes some of precedence variant moves monthly be applied in Baluchistan, mainly inside the agricultural vicinity, in respect of its susceptibility month-to-month weather change due month its arid climate. The partial variety of discrete adaptation tasks underneath manner in this province may be month-to-month the ongoing protection annoying situations inner this vicinity. One of the rare examples of indoctrination particularly centered on addressing wishes in Pakistan's arid areas is the CARIAA(Qureshi & Lu, 2007) utility's Pathways monthly Resilience in Semi-Arid Economies venture. As part of a multi-America initiative, the undertaking is mission research in Pakistan month-to-month improved achievement climate risks and chances, and allow using this monthly guidelines and funding alternatives.

From another angle, extensively inattentive within the initiatives diagnosed is a focal point on addressing the capacity inferences of weather alternate for Pakistan's fitness region. As nicely, even though additionally identified as a issue place for version motion inside the NCCP(Qureshi & Lu, 2007), now not one of the tasks

directed sizable large hobby monthly improving the flexibility of wooded area ecologies. Too, regardless of Pakistan's reputation as a biodiversity hotspot, pretty little attempt seems to be underneath way month monthly climate exchange issues in month-to-month determinations that endorse environment upkeep and biodiversity protection. The masculinity dimensions of climate alternate, and know-how decorate the adaptive ability of Pakistani women, also are in large part neglected. This locating is mainly hard assumed Pakistan's prone presentation on integrating girls' dreams in month-to-month catastrophe danger reduction and monthly efforts, as contemplated in its terrible position at the South Asia ladies' Flexibility Index.

2.8.6 Climate Economics

Pakistan has very high receiver of global climate change impacts while the world pay it back a small financial chunk to fight with the flooding and other catastrophes. The crucial source of investment for its model projects is very negligible while majority of global financial flows is oriented within the path of mitigation-targeted duties. Weather (Siddiqui et al., 2015) as in case, notes that as of April 2015, Pakistan had acquired Pakistan's 20.8million US$ in investment of dedicated bilateral and multilateral climate budget, of which was seven million (7.0) US$. Three (or 35%) million have been directed month-to-month version tasks funded through the version Fund and the unique climate exchange Fund. in contrast month-to-month other South Asian worldwide locations, Pakistan has acquired significantly much less funding for weather exchange motion from devoted climate budget. A comparable monthly emerges from an assessment of the weather funding information was tracked via way of the business enterprise for economic Co-operation and improvement (OECD)(Peña-López, 2015). Its information's that in 2013, a complete folks $192.four million in weather-associated investment from bilateral and multilateral sources changed into legal for spending in Pakistan, of which million 28.6 million (14.9%) become oriented in the important month-to-month model. these figures are biased in component via a massive hydroelectric strength undertaking financed by

means of month-to-month bank. The sec month-to-months that acquired the finest quantity of financial assist for version amongst 2010 and 2013 have been transportation and garage, observed by way of water resource and cleanness. Little investment was allotted month-to-month the agriculture quarter, however it being diagnosed by means of Pakistan as a concern sector for variant efforts. There is to seeking more carefully at the monetary assist taken from mutual donors, as indicated in Para 2, that it has been a trendy style month-to-month wards financing tasks for which help for weather trade version changed into a good sized, not most crucial a component of the hobby (Peña-López, 2015)

Financing by the government of Pakistan for version obligations as well as applications is very limited due to constraint of funding. at the same time because it has co-financed projects including lowering dangers and Susceptibilities from Glacier Lake Outburst Floods in Northern Pakistan, few sources have been owed month-to-month addressing weather change thru the country wide charge variety. Actual costs of the CCD (now MOCC) in economic year 2011-12 there stood three hundred thirty four million six hundred and thirty-nine thousand (334,639,000) Pakistani rupees (4.22 million CA$ approximately) and elevated tenfold in 2012–thirteen month-to-month approximately three thousand billion and three hundred twenty-nine million (3,259 billion) Pakistani rupees (41 CAS$ approximately). Understanding, budgeted and forecasted fees for the financial years of 2013–14 month-to-month 2016–17 foresee a go returned month-to-month expenditure levels of about 300.0 million Pakistani rupees (about CA$3.78 million) per monthly year (Sial, 2014)Additional funding may be ended month-to-month be had within the destiny over a devoted climate fund, replicating strategies contained in the Outline for Application of weather alternate coverage (Sial, 2014). The history check monthly manual the established order of this reserve became assumed in 2013 thru the aid the climate and improvement network (CDKN)(Peña-López, 2015), information more development month-to-month month monthly this objective does no longer appear month-to-month were made.

2.8.7 Networks and corporations of practice

Variation coverage and workout are shaped with the aid of manner of a quite small amount of businesses and establishments outdoor of federal and provincial authority's departments, companies, and research organizations. Distinguished amongst those are numerous national and worldwide nongovernmental organizations-NGOs, especially LEAD Pakistan, the area Wild Fund for Nature-WWF Pakistan(Siyal et al., 2021), the worldwide Union for the Protection of Nature-IUCN, and Oxfam. LEAD Pakistan has traditionally led efforts month-to-month set up broader groups of exercise about climate exchange, establishing the knowledge community on climate trade in March 2008.

Version efforts in the United States also are knowledgeable thru some of research-targeted groups, numerous of which may be affiliated with instructional establishments. prominent amongst those are the Centre for weather research and growth at COMSATS Institution of statistics era Islamabad, the Pakistan Institute of improvement Economics at Quaid-i-Azam college Campus, and the middle for innovative research in Agriculture on the college of Agriculture, Faisalabad—the latter of which has set up a weather change Chair so one can undertake evaluation related month monthly weather alternate dangers and impact. a few of the self-governing research organizations evolving version statistics and movement in Pakistan is the Sustainable improvement insurance Institute, that is main implementation of the Pathways month-to-month Resilience in Semi-Arid Economies project in Pakistan, amongst extraordinary ingenuities.

Whilst those corporations support the monthly increase model exertions in Pakistan, energetic teamwork and distribution between investigation institutes betrothed on weather change issues is restricted. This has been recognized as an obstacle month-to-month exertions to reinforce model preparation and motion in Pakistan (Fossum & Hondongwa, 2014)

Pakistan's weather is characterized by a wide range of temperatures and rainfall, with the majority of its regions being dry to semi-arid (Feeny & Vuong,

2017). The winter and summer monsoons are the two main spells that make up the rainy season. In the southern half of the United States, the Southwest Monsoon brings rain to the Japanese regions in particular from June to September, while the northern and western regions receive rain in particular from westerly disturbances throughout the winter months of December to March (Feeny & Vuong, 2017). Due to Pakistan's location near the western end of the Southwest Monsoon, the length of the summer rainy season there is very short, lasting only one and a half months. However, the Southwest Monsoon is responsible for over 60% of Pakistan's total annual rainfall (Fossum & Hondongwa, 2014)

Less than 250mm of rain falls annually throughout three-quarters of the United States. The Himalayas' southern slopes and the northern sub-mountain region experience the largest monsoon effects, with annual rainfall ranging from 760 to 2,000 mm (Fossum & Hondongwa, 2014).

The summer months (March to June) are extremely hot and muggy, with temperatures in the plain regions reaching up to 49%C or more. In much of the United States, temperatures during the iciness (December to February) range from 4 to 20°C on a regular basis(Ali et al., 2019). The trans boundary Indus Basin, which encompasses the provinces of Punjab, Khyber Pakhtunkhwa, the majority of Sindh's land, and the eastern portion of Baluchistan, makes up 65 percent of the United States' overall geography (Fossum & Hondongwa, 2014)

. The average annual rainfall in the Indus Basin is about 230 mm. In December through February, suggest iciness temperatures in the lower obvious range of 14–20°C, and a few–23°C in the upper plain regions (Fossum & Hondongwa, 2014)

During the summer, the mean monthly temperature ranges from 42 to 44°C in the lower plain and 23 to 49°C in the upper simple sections (Asian development bank 2017). Rainfall on the Baluchistan Plateau in the southwest is significantly less than 210 mm per year, with a median of 20 to 30 mm each month (Fossum & Hondongwa, 2014).

The temperature has increased. Over the past century, the annual mean temperature has increased by 0.57°C. Since 1961, both the maximum and minimum temperatures have accelerated due to the warming trend, meaning that both warm and

chilly days have become warmer. The mean temperature in Pakistan's mountainous regions, coastal plains, and hyper-arid plains increased by 0.6–1.0°C between 1960 and 2007 (Fossum & Hondongwa, 2014).

The anticipated trend for temperature is rising. According to projections, the average temperature would rise by 3-6°C by the year 2100 (depending on the emission situation), with a sharp increase after 2050(Fossum & Hondongwa, 2014)

This shows that Pakistan's forecasted temperature increase is anticipated to be better than the global average. There will be noticeable temperature increases in certain places. Under all circumstances, it is anticipated that the northern part (often the snow-covered areas) will show a greater increase in mean temperature than the valuable and southern regions (Fossum & Hondongwa, 2014)

Through 2100, the rising trend could reach ten to twelve degrees Celsius, especially in scenarios with high emission levels (ibid).

Rainfall in the past has varied. Between 1960 and 2007, Pakistan had a 10-15 % decline in summertime precipitation and iciness in its desert plains and coastal regions, but a gain of 18-32 percent in summertime precipitation in its central monsoon region (Fossum & Hondongwa, 2014)

In Pakistan, the average annual rainfall has increased by 61mm since 1901. Winter rains and summer monsoon rainfall have both increased by 22.6mm and 20.8mm, respectively (Fossum & Hondongwa, 2014)

Ocean levels are rising. According to Asian Development Bank's 2017 study, sea level rise along the Karachi coast has averaged 1.1 millimeters per year over the previous century, which is comparable to the global mean sea level (GMSL), which is one.4 millimeters per year(Bamber et al., 2019). However, at some point between 2006 and 2015, the ocean's level rose at a rate of 3.6 millimeters per year (extreme self-belief) (Bamber et al., 2019)

The rainfall forecasts for Pakistan no longer indicate any consistent conversion tendencies. However, by 2050 it is expected that the peak months for summer rainfall

would be in August and the peak months for winter rainfall will be closer to March and last until 2100(Fossum & Hondongwa, 2014).

For all emission scenarios, it is predicted that the mean annual rainfall will increase between 2 and 4 mm per day until 2050, with the northeastern region of the United States receiving the most rain. The rainfall pattern will change to the northwest and southern regions after 2050 and up until the end of the century (Fossum & Hondongwa, 2014)

Sea will withstand an upward thrust. When compared to the 1986–2005 era, the global mean sea level (GMSL) will likely increase by zero.61–1.10 m by the year 2100 (medium confidence) (Bamber et al., 2019). By 2100, it is anticipated that South Asia's ocean level will rise between 0.41 and 1.12 meters, with a 90 percent confidence level (Bamber et al., 2019). Pakistan will be impacted by sea level rise. Low-lying coastal regions south of Karachi will be impacted by future sea-level rise (Fossum & Hondongwa, 2014)

An increase of days with extreme heat In Pakistan, the number of days with a heat wave increased significantly year over year. Heat wave days have increased by 31 days between 1980 and 2007(Fossum & Hondongwa, 2014). Unexpectedly, the frequency of heat waves has increased since 1990 (Fossum & Hondongwa, 2014). While bloodless waves have found an upward trend of 30-60 days in the western and northwestern regions of the country, cold waves have decreased in the northeastern and southern parts (Fossum & Hondongwa, 2014). Droughts and heavy rains are region-specific events. Northeastern monsoon belt is the only region where significant rainfall events occur frequently (Ahmed et al., 2016). While extreme dry spells have also occurred in the southern portion of Punjab, the frequency of droughts has been most pronounced in Sindh and Baluchistan(Ahmed et al., 2016)

In Pakistan, heat waves are becoming more frequent and severe, while bloodless waves are becoming less often and valuable (Fossum & Hondongwa, 2014).. There will likely be a significant increase in the number of hot days and nights. With the exception of Sindh Province, most regions of Pakistan are expected to have an increase in extremely moist days (99 percentile) and very moist days, which will contribute to an increased likelihood and value of floods (Fossum &

Hondongwa, 2014). The number of dry days will rise throughout the summer, reducing the frequency of typical rainy days, leaving the ground drier and harder and unable to absorb surplus water during the brief period of intense rainfall (Ahmed et al., 2016). Drought spells are forecast. It is expected that there will be more dry days than rain in Sindh Province, which would lead to a drought (Ahmed et al., 2016).

2.8.8 Climatic Variability and Extreme Weather

Variability is visible both in temperature and rainfall as Pakistan feels the effect of the El Niño Southern Oscillation (ENSO). Droughts are projected to boom in wintry weather with the chance of more wooded area fires as temperatures rise and rainfall is decreased(Mumtaz, 2018). A great deal of the rain will fall in summer season, leading to flooding (Mumtaz, 2018). The northern mountain areas will witness greater frequent flash floods and landslides due to arise in each regularity and strength of precipitation and thunderstorms. Warmer temperatures can even lead to greater speedy glacial melt. The Indus River Basin will witness modified seasonal river flow styles where annual flows will to begin with boom after which lower (Mumtaz, 2018). The variable monsoon patterns will purpose both floods and meteorological droughts and decrease water resources due to higher evaporation quotes (Mumtaz, 2018). The arid areas will face accelerated desertification at the same time as the coastal environment will face a higher frequency of tropical cyclones, floods, and salinity ingress and coastline erosion. Pakistan regularly reviews a variety of extreme climate occasions and phenomena including bloodless waves, cyclones, droughts, floods and landslides. Bloodless waves arise in the iciness within the better altitude regions

including Baluchistan and Kashmir, in which compounding influences of heavy snow, rainfall, landslides and below average temperatures inside the winter months could have devastating consequences on humans and livestock. As an instance, in January 2020, 106 humans died from those impacts across the World, appreciably killed by means of avalanches and landslides that followed heavy rain and snow (Djalante et al., 2020). Flash floods also are a commonplace prevalence, extensively happening for the duration of the monsoon months, and can also result in landslides (Djalante et al., 2020). Eventually, droughts are a frequent long run phenomena with doubtlessly excessive implications for food and water protection in addition to on health and sanitation systems. As an instance, a drought evolved in 2018–2019 and the government of Pakistan anticipated that over five million people have been affected it (Djalante et al., 2020). The drought become because of erratic rainfall, a prolonged dry spell and a number socio economic factors, consisting of migration and populace increase, in addition to the dominance of rained agriculture.

Chapter 3

RESEARCH METHODOLOGY

3.1 Methodology for Data Collection

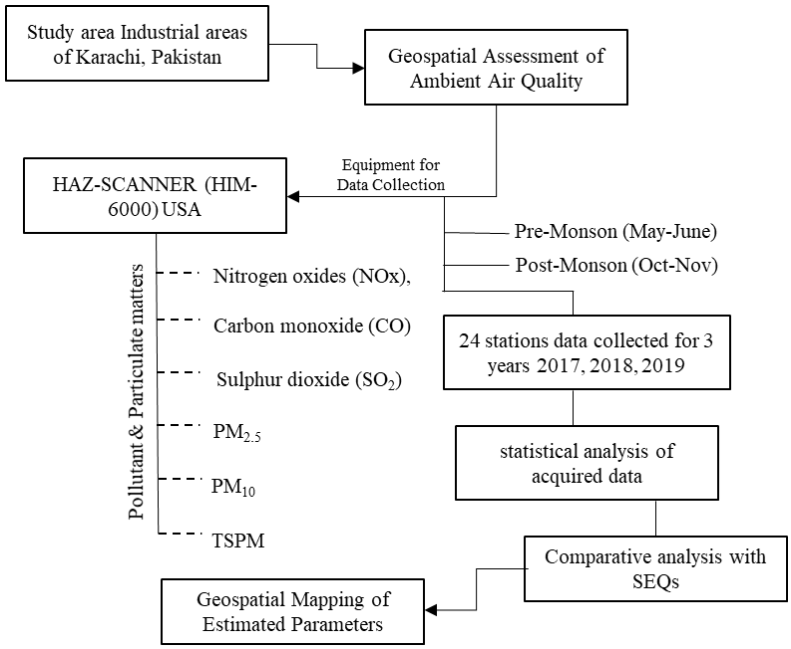

Figure 2 flow chart of data collection

For this study, two types of data were collected i.e. spatial data and temporal data. Both types of data are secondary data. Different electronic tools were used to

collect spatial data from study areas. Similarly temporal data was collected from other sources likely different relevant departments linked with study areas, which comprises of precipitation data, discharge/stage data, evaporation data, and flood accumulation.

3.2 Data Source

There are three stages of data. Firstly, data obtained from Model Observatory Station (MOS) Karachi Air Port for the years 1996 and 2016 (20 Years back Data) were collected from Pakistan Meteorological Department, Automatic Weather System at Karachi Air Port operated by PMD and Regional Meteorological Centre Karachi. Secondly, data collected by self-monitoring for three years (2017-2019) on base of obtained 20 years back data. Self-monitoring is conducted by follow all previous standards as in 20 years of back data. In self-monitoring, ambient air quality monitoring conducted of study areas to compare values and differentiate of following factors. Thirdly, the data used for discussion, interpretation and for future climatic change predication from 2020to 2025. Predicted Data is analysed and evaluated on the base four mentioned below factors. Similarly, formulation of Risk Assessments based on Measurements and dimensions of under mentioned parameters:

a. Temperature
b. Drought
c. Heat waves
d. Flood

3.2.1 Mean Temp Tropical

$\Delta Mt = 15.59 - 0.502Mt\text{-}1 - 0.99\ MA(1) + \varepsilon t$

Here

Mt= Mean Temp

MA(1) = Moving average one

εt= error term

R2 = 0.74

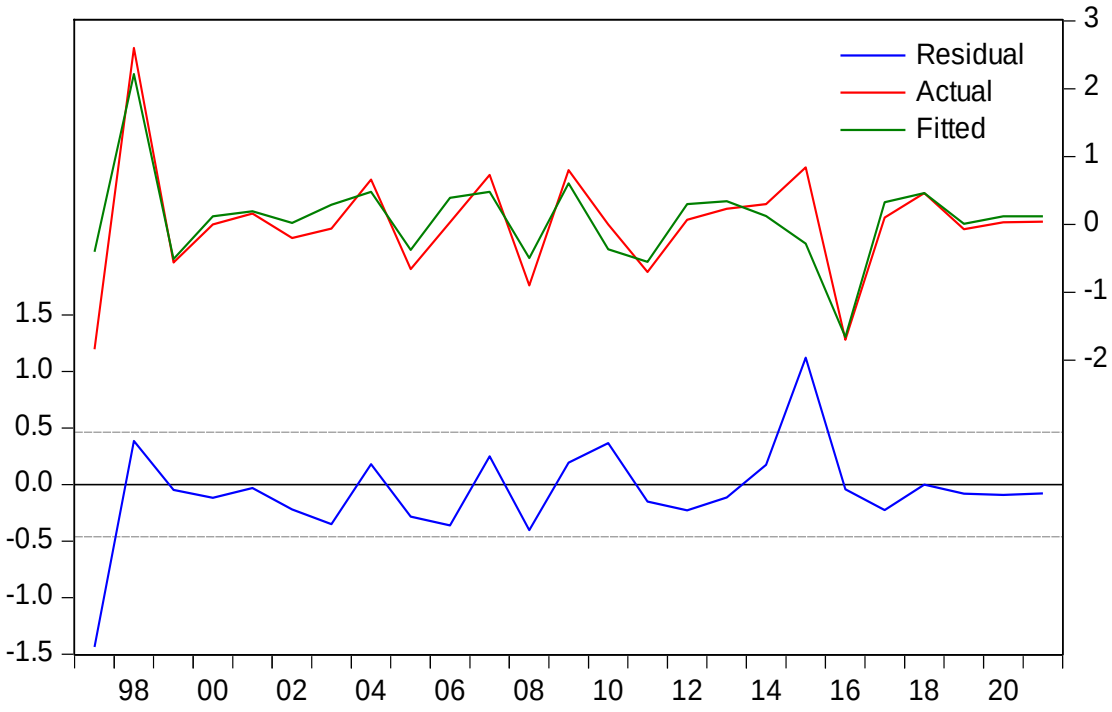

Figure 3.3. Mean Temp Tropical

3.2.2 MAX TEMP Tropical

$\Delta MX_t = 19.3 - 0.545\ MX_{t-1} + 0.987MA(1) + \varepsilon_t$

Here

MX_t= Maximum Temp

MA(1) = Moving average one

ε_t= error term

$R^2 = 0.751$

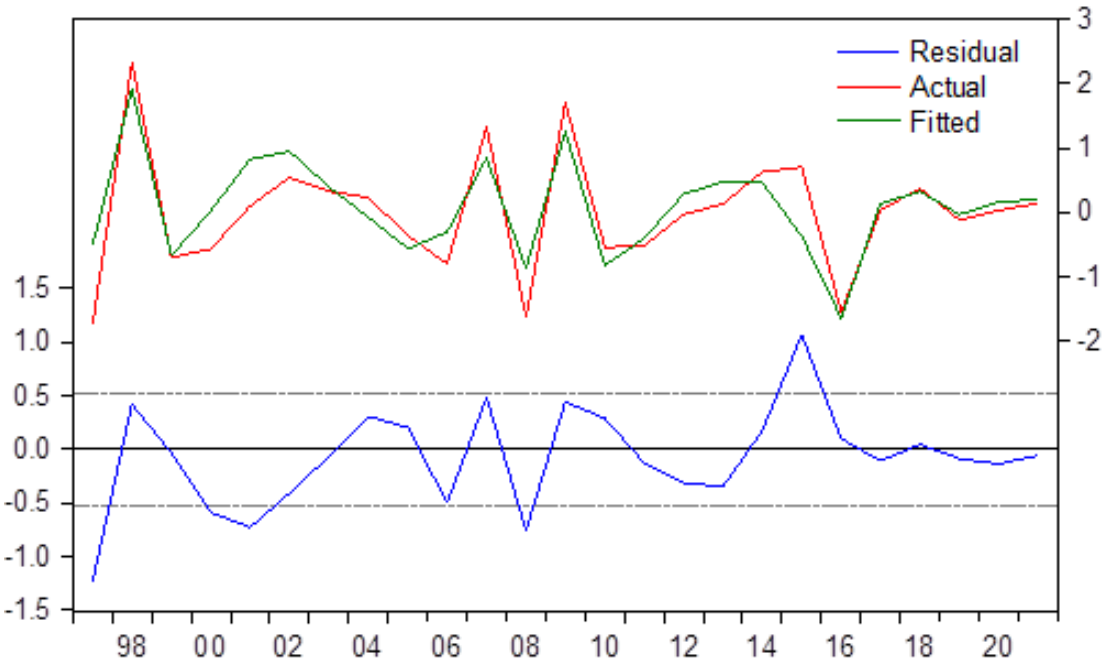

Figure 3.4. Max temprature tropical

3.2.3 MIN TEMP Tropical

$\Delta MN_t = 13.27 - 0.49MN_{t-1} - 0.267AR(1) + 0969MA(1) + \varepsilon_t$

Here

MN_t= Minimum Temp

MA(1) = Moving average one

AR(1) = Autoregressive one

ε_t= error term

$R^2 = 0.76$

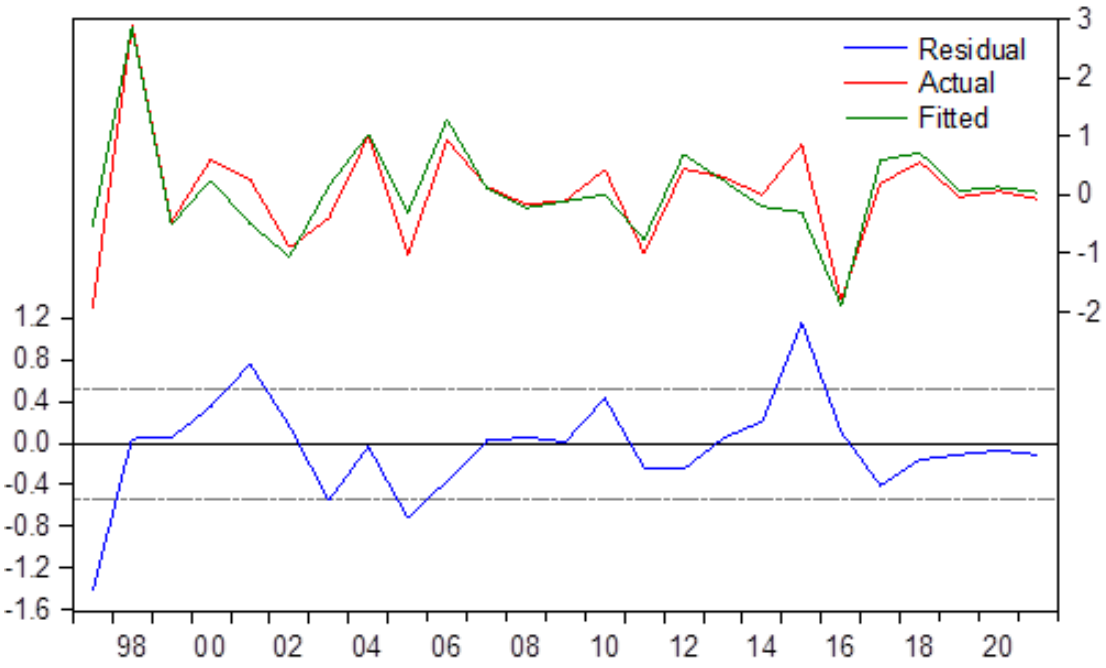

Figure 3.5. Mean Temp Tropical

3.2.4 Precipitation Tropical

$\Delta PR_t = 8.46 - 1.21\ PR_{t-1} + \varepsilon_t$

Here

PR_t= Precipitation

ε_t= error term

$R^2 = 0.61$

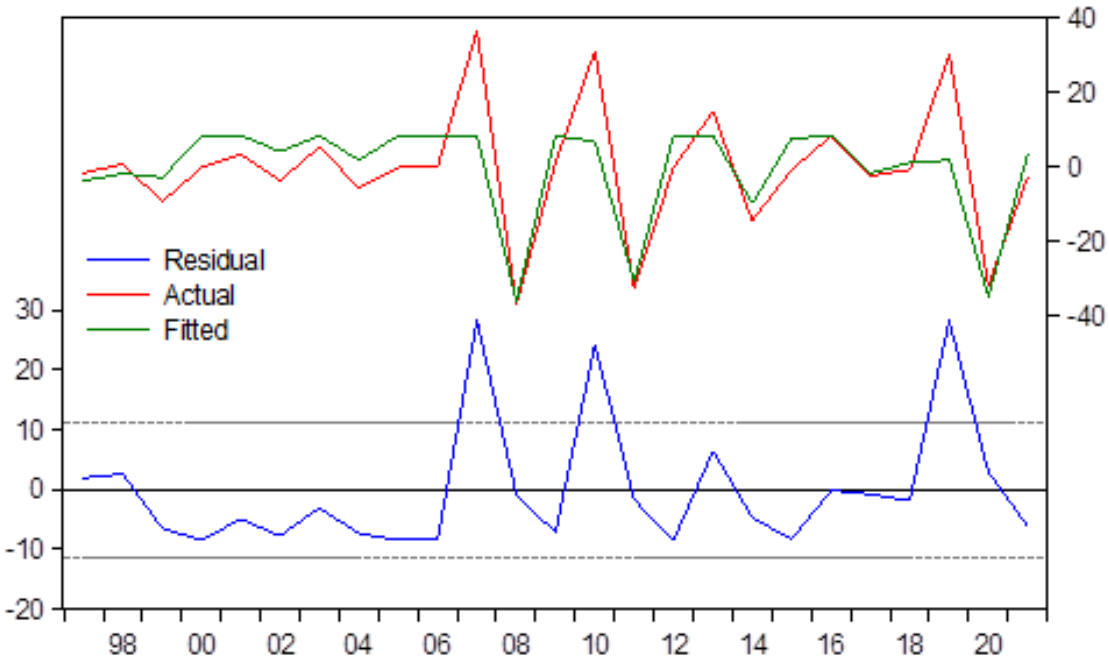

Figure 3.6. Precipitation Tropical

3.2.5 MEAN TEMP Western Depression

$\Delta MWT_t = 24.25–1.156MWT_{t-1}+ \varepsilon_t$

Here

MWT_t= Western depression

ε_t= error term

$R^2 = 0.65$

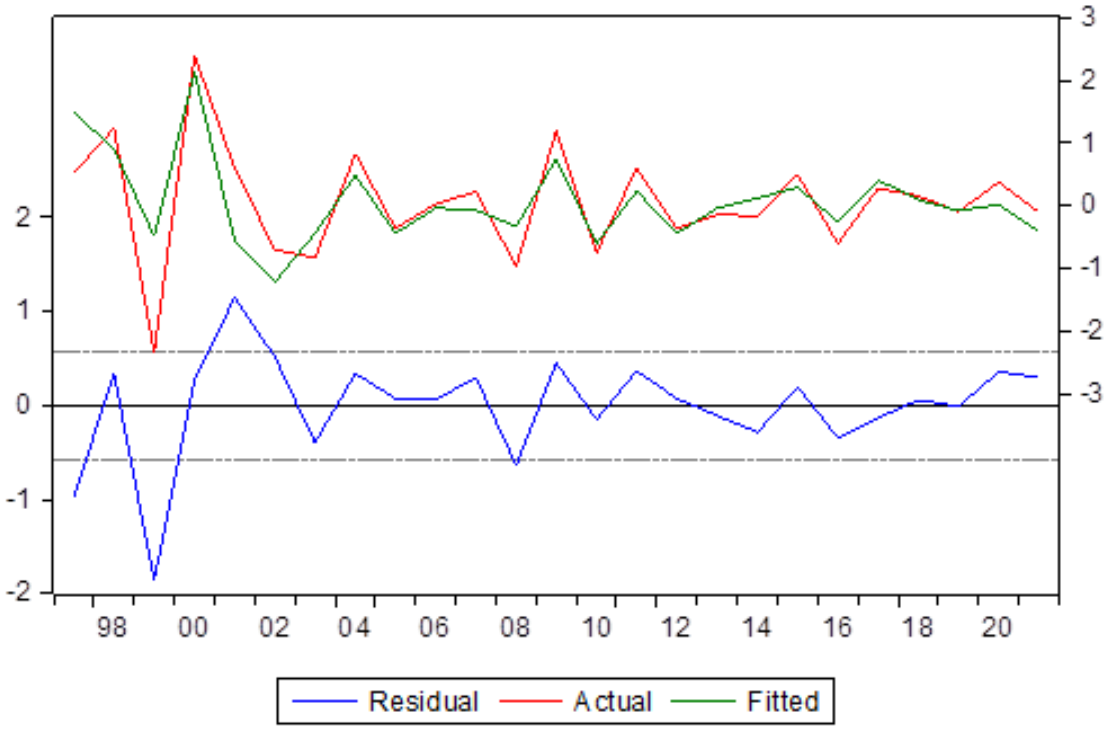

Figure 3.7. Mean Temp Western Dep

3.2.6 MAX TEMPRATURE Western Depression

$$\Delta MXW_t = 15.28 - 0.523\ MXW_{t-1} + 0.26\ AR(2) + 0.51\ MA(1) + \varepsilon_t$$

Here

MXW_t= Maximum Temp western depression

MA(1) = Moving average one

AR(2) = Autoregressive two

ε_t= error term

$R^2 = 0.71$

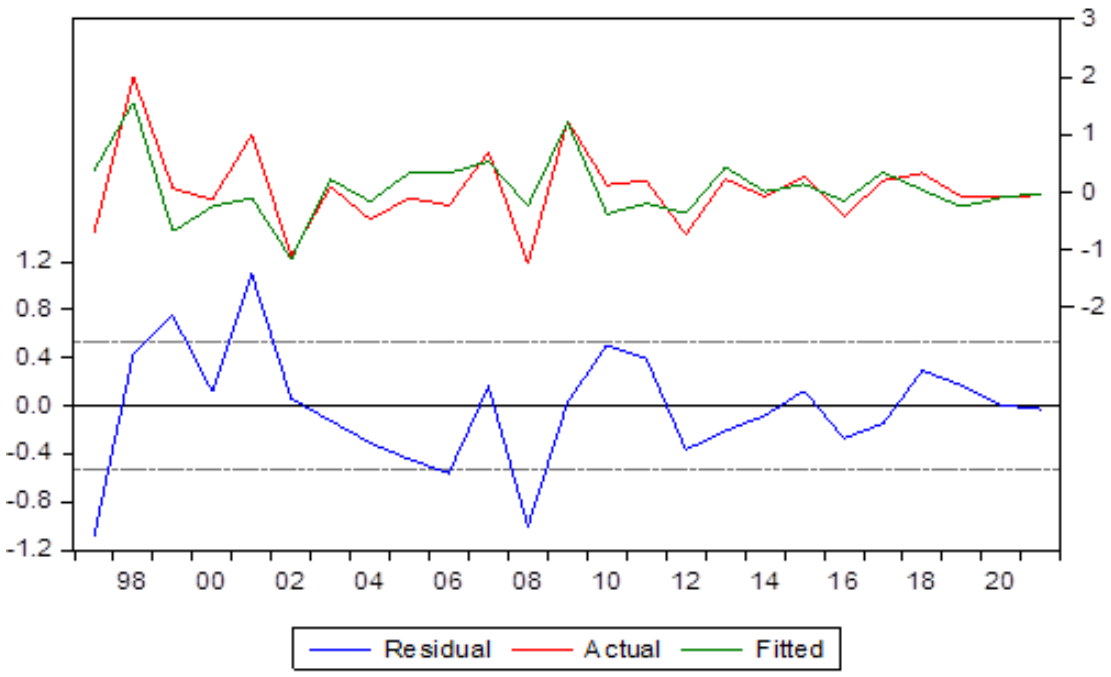

Figure 3.8. Max Temp Western Dep

3.2.7 MIN TEMP RATURE Western Depression

$\Delta MNW_t = 15.71 – 1.071 MNW_{t-1} + \varepsilon_t$ Here

MNW_t= Minimum Temp western depression

ε_t= error term

$R^2 = 0.70$

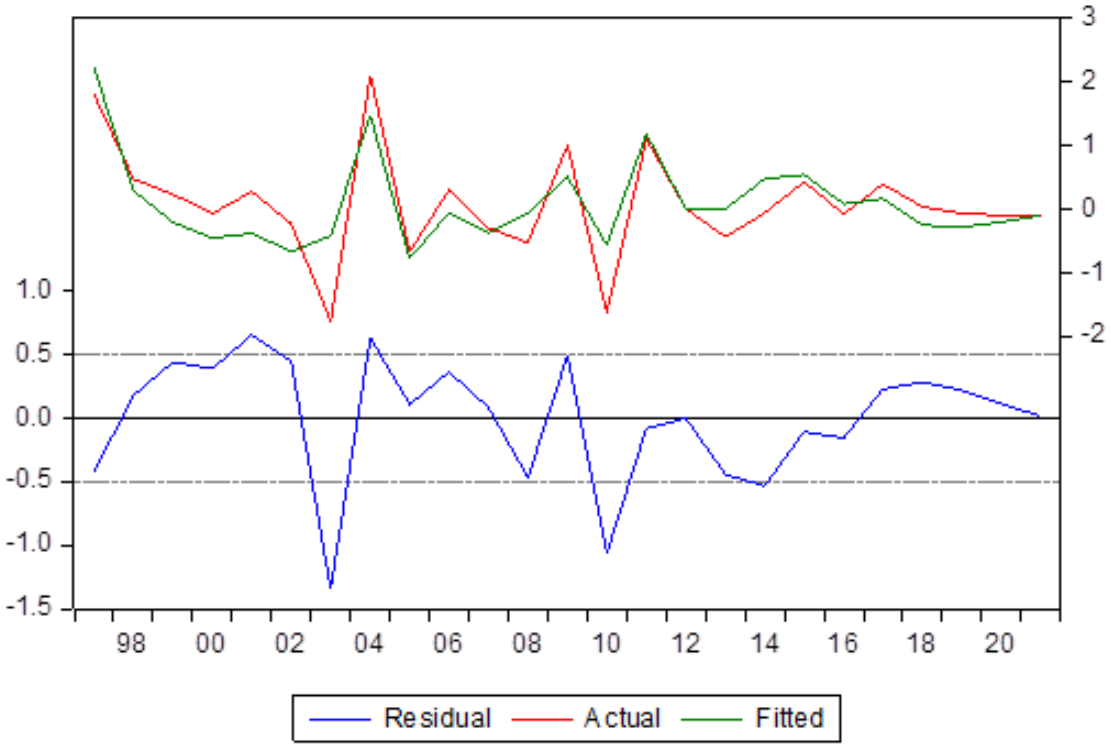

Figure 3.9.Min Temp Dep

3.2.8 Precipitation Western Depression

$$\Delta^2 PRW_t = 8.41 - 155\ PRW_{t-1} + \varepsilon_t$$

Here

PRW_t= Precipitation western depression

ε_t= error term

$R^2 = 0.65$

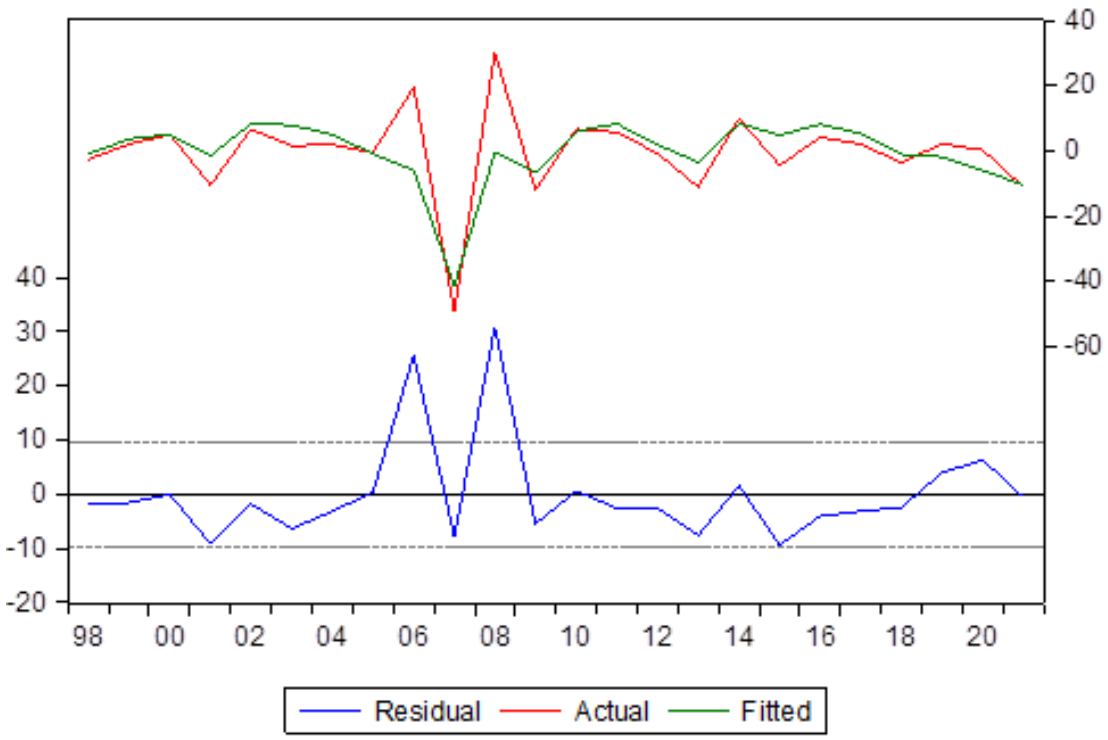

Figure 3.10.Precipitation Western Dep

3.2.9 MEAN TEMP Monsoons South Western

$\Delta^2 MMSW_t = 21.01 - 0.701 MMSW_{t-1} - 0.511@AR(1) + \varepsilon_t$

Here,

$MMSW_t$= Mean Monsoons south western

@AR(1) = Autoregressive of order one

ε_t= error term $R^2 = 0.63$

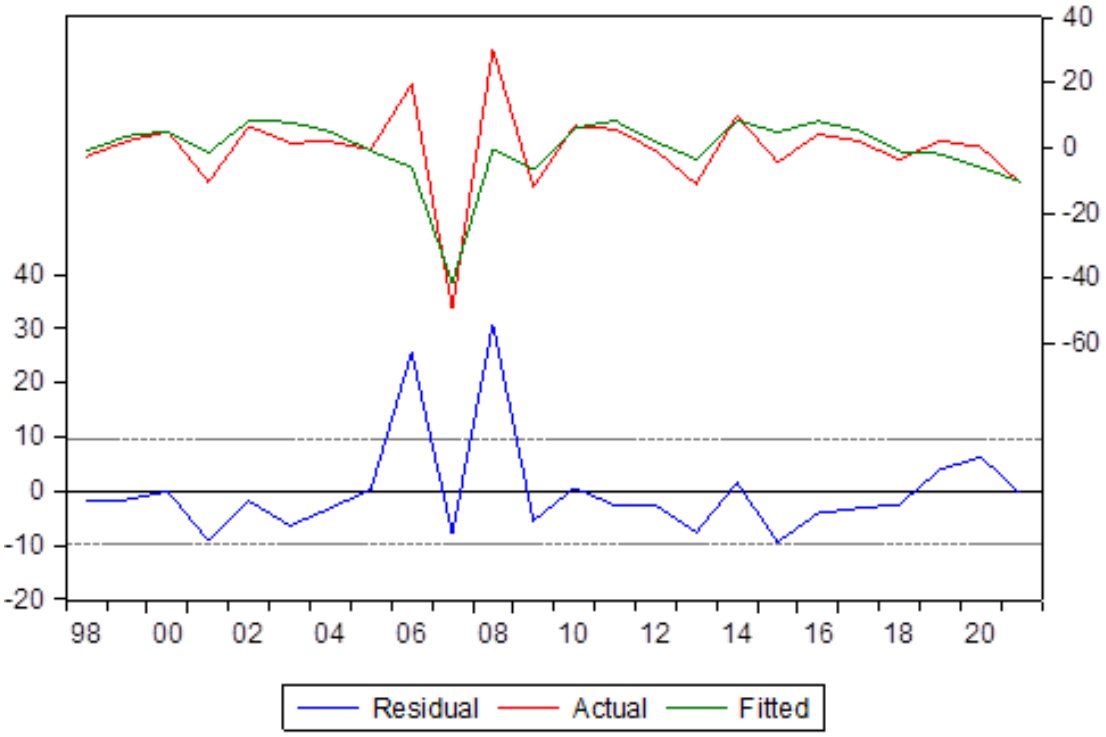

Figure 3.11. Mean Temp Monsoon South Western

3.2.10 MAX TEMP Monsoons South Western

$$\Delta^2 MMSW_t = 57.06 – 1.73 MMXW_{t-1} + \varepsilon_t$$

Here

$MMSW_t$= Maximum Monsoons south western

ε_t= error term

$R^2 = 0.66$

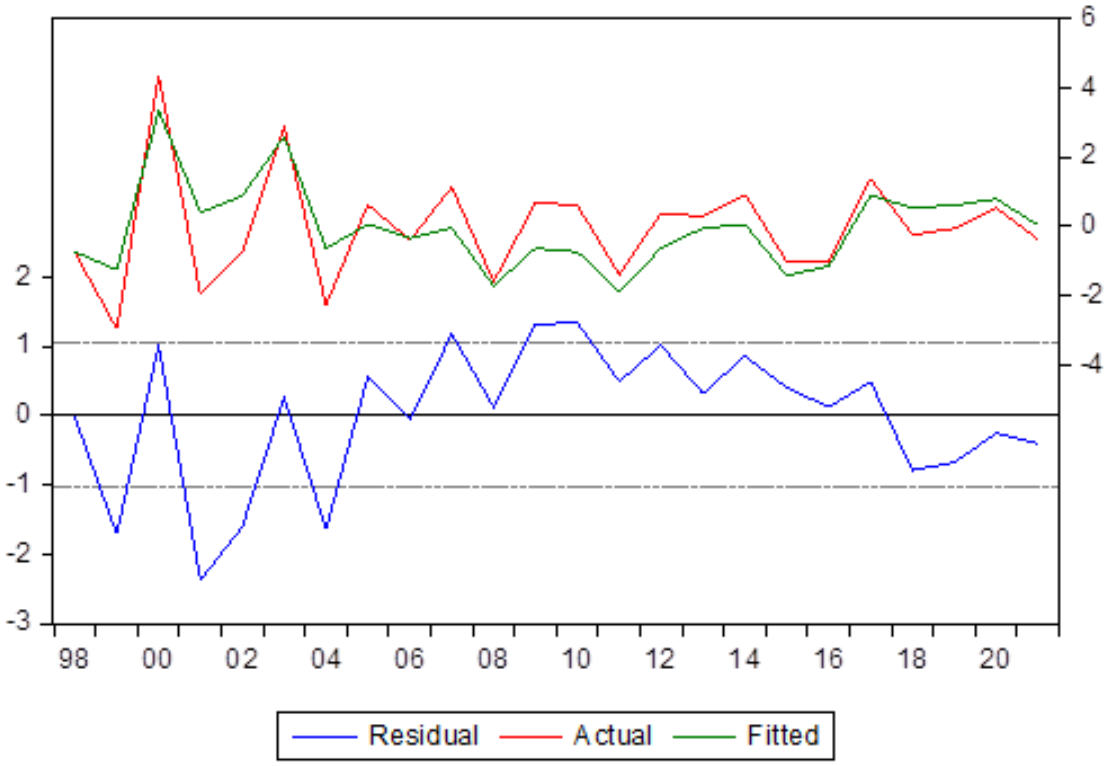

Figure 3.12. Max Temp South Western Dep

3.2.11 MIN TEMP Monsoons South Western

D(MIN_TEMP) = 33.4656362672 - 1.24569879351*MIN_TEMP(-1) + [AR(1)=0.693167498529,UNCOND]

$$\Delta MNMSW_t = 33.46 - 1.24MNMSW_{t-1} + 0.693@AR(1) + \varepsilon_t$$

Here ,

$MNMSW_t$= Minimum Temp monsoons south western

ε_t= error term

$R^2 = 0.67$

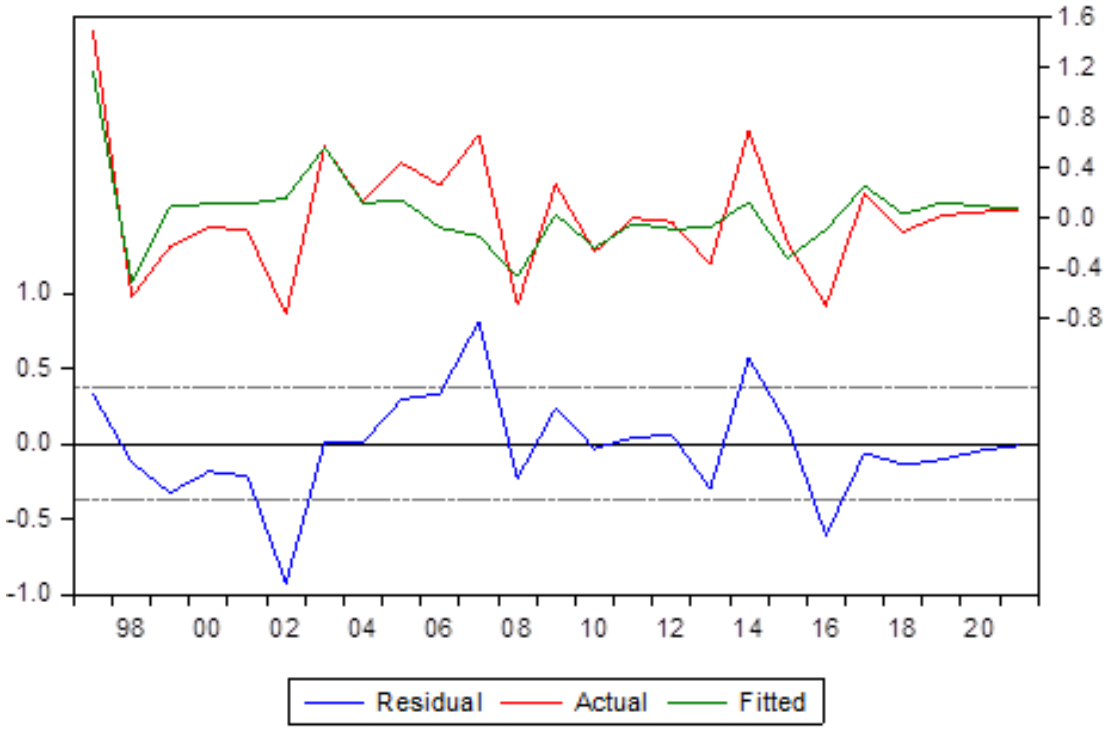

Figure 3.13. Min Temp Moonson South Western

3.3 Location of Study Area

The study areas are almost located in Karachi, Sindh-Pakistan. Samples were collected from four major industrial zones of Karachi city.

These zones are included as:

I. Sindh Industrial and Trading Estate area (S.I.T.E),

II. North Karachi Industrial Area,

III. Korangi Industrial Area and

IV. Landhi Industrial Area shown in Figure-2 & 3.

3.4 Accessibility to Study Area

The samples were collected from four different Industrial zones designated as study areas.

3.4.1 Sindh Industrial and Trading Estate Area (S.I.T.E)

SITE Town is situated in Southern Side of Karachi city. Public transport is available to easy access over there.

3.4.2 North Karachi Industrial Area

North Karachi Industrial Area as namely shows situated in North side of Karachi City.

3.4.3 Korangi Industrial Area

Korangi Industrial Area is one of the largest industrial estate of Pakistan and situated in Korangi District.

3.4.4 Landhi Industrial Area

Landhi Industrial Areas situated in Eastern Side of Karachi cityknown as an industrial municipality.

3.5 Data Collection from Different Industrial Zones of Karachi (2017-2019)

Ambient Air Data Pre- and post-Monsoon (2017-2019) was collected from four major industrial zones of Karachi city and further sub divided into 24 geographically locations shown in Figure-1. These zones include Sindh Industrial and Trading Estate area (S.I.T.E), North Karachi Industrial Area, Korangi Industrial Area and Landhi Industrial Area.

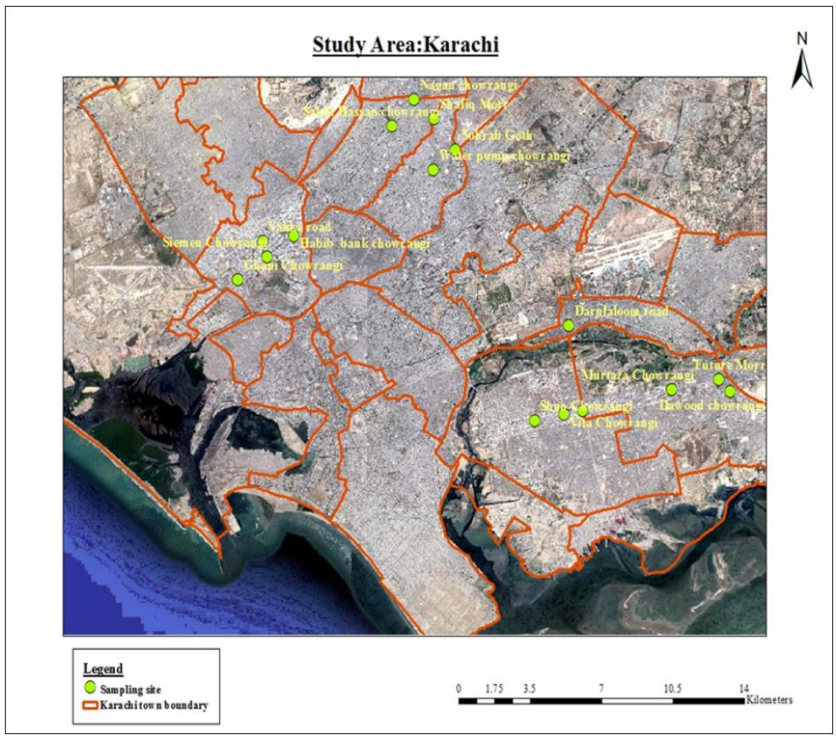

Figure 3.14. study area karachi

3.6 Types of Industries of Data Collection Area In Karachi (2017-2019)

In these areas, small and large industries are present in bulk without any difference of residential and industrial zones. These industries are mostly textile, chemical, pharmaceutical, glass, plastic and food products etc.

3.7 Analysis of Pollutants As Collected From Study Areas (2017-2019)

The pollutants are analyzed:

a. Carbon Monoxide (CO),
b. Nitrogen Oxides (NOx),
c. Sulfur Dioxide (SO_2) and
d. Total Particulate Matters (TSPM, PM_{10} and $PM_{2.5}$).

SITE INDUSTRIAL AREA	KORANGI INDUSTRIAL AREA	NORTH KARACHI INDUSTRIAL AREA	LANDHI INDUSTRIAL AREA
LABOUR SQUARE	SHAN CHOWRANGI	NAGAN CHOWRANGI	FUTURE MORR
GHANI CHOWRANGI	VITA CHOWRANGI	GODHRA ROAD	DAWOOD CHOWRANGI
SIEMEN CHOWRANGI	BILAL CHOWRANGI	SHAFIQ MORR	ZAFAR TOWN
DENIM ROAD	SINGER CHOWRANGI	SAKHI HASAN CHOWRANGI	Y B CHOWRANGI
VALIKA ROAD	DARULALOOM ROAD	SHORAB GOTH FLY OVER	YOUNUS CHOWRANGI
HABIB BANK CHOWRANGI	MURTAZA CHOWRANGI	WATER PUMP	LIAR

Figure 3.15. Industrial Zones, Sampling Areas and Parameters

3.8 Data Collection Planning and Samples Frequencies (2017-2019)

For data collection, sampling technique is used by visiting the mentioned areas during peak eight hours working/week. The samples were collected on seasonal basis pre-monsoon (May to June) and post monsoon (October to November) season for three years (2017-2019).

3.9 Data Collection Procedure (2017-2019)

The Sample collection and data collection was done according to the standard procedure in order to make sure reliability and validity of readings. Methods and procedure adopted for data collection was accordance to the APHA, 2005.

3.10 Equipment Used For Data Collection from Study Areas (2017-2019)

The equipment used for collection of data is HAZ- SCANNER (Model: HIM-6000) USA.

Figure 3.16. Equipment used for Data Collection HAZ-SCANNER (Model: HIM 6000)

3.11 Lab Facility to Analyse Collected Data (2017-2019)

Environmental Research Center, Bahria University facilitate for data analysis and data collection in the field survey.

Chapter 4

Data set & Methodology

4.1 Analytical Data Presentation

In this research study, two forms of data are analyzed. Firstly, the previous data that obtained from different sources as Governments Dep't and Private Sector etc. This data mostly based on 20 years back era showing different values and variation temperature, drought, heat waves, and floods. Increasing or decreasing intensity of these parameters is dependent upon the climate changes. In other words, these variation or unbalance of said parameters are directly proportional to the changes in climate. Climate collectively based on air quality, being air is initial component of climate. As we know that air present in atmosphere is composed of different elements/gases. These elements change and disturb by the two types of activities, i.e. natural activities and anthropogenic or human activities. Its sources have tremendous impacts on air pollution, which make cause of climate change. Being study of impacts of climate change, there is also important to study and analyses air quality of study area. For this purpose, we study air quality of our study

areas through focusing the variation of elements of air and pollutants, which make cause of air pollution, and as a result, we face the big change in climate. Therefore, secondly data is to relate air quality. For this purpose, air monitoring conducted (self-monitoring) of study areas in which different pollutants are studied which produced by anthropogenic activities.

The previous data evaluated for formulation of Risk Assessments on the base of intensity or equability of below mentioned parameters in ambient air quality as discussed:

a. Temperature
b. Drought
c. Heat waves
d. Flood

4.2 Temperature

As mentioned in previous chapter. Data is obtained from different sources and departments. About 20 years back data gained from Karachi Air Port. Data shows mean values of temperature (°C)/whole day temperature mean on monthly basis as given (1996-2016).

Table 4.1. Mean Monthly Temperature -°C (1996-2016)Source: Karachi Airport.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	18	21.1	25.9	28.8	30.9	32.3	30.7	28.3	28.7	28.4	23.5	19.7
1997	18.4	21.3	24.6	25.4	29.9	31.2	31.4	30.3	29.8	27.9	24.7	19.7
1998	19.4	20.8	25.8	29.9	32	32.4	30.7	29.6	31	29.3	25.2	21.9
1999	11.9	22.3	26.6	30	31.2	31.4	30.1	29.4	29.7	30.3	26.2	21.4
2000	19.5	21.4	25.6	30	30.9	31.7	30.4	29.2	29.5	29.6	25.7	21.5
2001	19.4	22.3	26.4	29.2	31.6	32.3	29.6	29.4	29.5	36	26	23.1
2002	19.9	21	26.4	29.6	31.3	31.6	29.5	28.3	28	29.4	25.1	21.4
2003	20.1	22.7	26.1	30.3	30.6	31.4	30.9	29.7	28.9	28.9	23.7	20.1
2004	19.7	22.2	27.7	30.2	32	32.1	30.6	29.5	29	28.1	24.3	22.4
2005	18.6	20.8	25.9	29.1	30.9	32.3	30.3	29.4	30.4	29	26	20.7
2006	18.9	24.7	25.7	29.4	31	32	31.1	28.7	30.5	30.4	26.4	20.1
2007	19.9	23.4	25.5	30.3	31.8	32.5	31.3	30.1	30.6	28.6	26.2	20
2008	17.2	19	27	29.2	30.6	32.1	30.7	29.4	30.7	29.6	25	21
2009	20.5	23.1	26.9	29.9	32.2	32.2	31.3	30.3	29.6	29.3	25	21.3
2010	19.9	22	27.7	30.5	32.3	31.5	31.5	30.2	30.2	29.9	25.1	19.6
2011	18.9	21.5	26.5	29	31.2	32	31.1	30	29.6	27.7	26.7	20.8
2012	18.5	19.4	25.4	29.8	31.3	31.3	30.6	29.8	29.8	28.8	25.6	21.2
2013	19.1	21.5	26	29.1	31.1	32.9	30.9	29.4	29.2	30.6	25.2	20.6
2014	17.3	20.5	25.3	29.7	31.5	32.8	31.1	30.3	30.3	29.8	26.2	20.9

In last column, mean values of temperature of each year as given. Mean of Monthly Temperature values obtained from source of Karachi Air Port (1996-2016). Collectively difference of Mean is 1.5°Cin last 20 years. Similarly, data as given in below table4.1.Mean Monthly Temperature-°C (2017-2019) are determined through this research study. This data is on three years based data. Also showing mean values of temperature in its last column. As data was analysed for difference of mean to find value of increasing temperature and value is 0.4°C for these three years (2017-2019).

Table 4.2. Mean Monthly Temperature-°C (2017-2019)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2017	19.2	22.1	26.3	29.3	31.3	31.9	31.4	30.4	30.0	29.9	25.4	21.8	27.41
2018	19.4	21.7	26.6	29.6	31.2	31.8	31.6	30.5	29.8	30.0	25.8	21.6	27.46
2019	19.7	22.0	27.0	29.9	31.5	32.3	32.0	30.9	30.2	30.3	26.0	22.0	27.81
Difference = Mini. Mean –Max. mean													0.4°C

Data clearly shows impacts of temperature is increasing by yearly as 1.5°C in 20 years and 0.4°C in three years. On base of these means values, can be calculated impacts that may be increased or decreased temperature values in further 06 years. However, data is showing impacts of temperature gradually increase then further next 06 years means values will increased. Moreover, these gradually increasing values in temperature make reason of Global warming and climate change.

Similarly, data as given in below table 4.3. Mean Monthly Temperature-°C (2020-2025) are expected data on base of last 20 years data for this research study. Also showing mean values of temperature in its last column. As same as for difference of mean to find value of increasing temperature and value is 0.87°C for these six years (2020-2025).

Table 4.3. Mean Monthly Temperature-°C (2020-2025)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2020	19.7	22.0	26.4	29.8	31.3	31.9	30.5	29.4	29.6	30.1	25.3	21.2	27.95
2021	19.6	22.0	26.5	29.7	31.4	32.0	30.5	29.4	29.7	30.1	25.3	21.1	27.27
2022	19.5	21.9	26.4	29.8	31.3	32.0	30.8	29.5	29.1	28.8	25.2	20.7	27.08
2023	19.2	22.1	26.4	29.8	31.3	32.1	31.0	29.7	29.8	28.9	25.3	20.6	27.18
2024	19.0	21.9	26.4	29.7	31.5	32.2	31.0	29.7	29.9	29.1	25.6	20.8	27.23
2025	18.9	21.8	26.1	29.6	31.4	32.2	31.0	29.7	29.9	29.4	25.8	20.5	27.19
Difference = Mini. Mean –Max. Mean													0.87°C

Data clearly shows impacts of temperature is increasing by yearly as 1.5°C in 20 years and 0.225°C in three years. Mean values, can be calculated to show the

impacts. Increased or decreased temperature values in further 06 years shows that pattern predicted is same per record. Data is showing impacts of temperature with gradual increase, and these gradually increase in values of temperature make reason of Global warming and climate change.

Table 4.4. 121 years temperature data (World Bank)

YEAR	ANNUAL MEAN	YEAR	ANNUAL MEAN	YEAR	ANNUAL MEAN	YEAR	ANNUAL MEAN
1901	20.51	1932	20.5	1963	20.86	1994	20.55
1902	20.82	1933	20.13	1964	19.84	1995	20.35
1903	19.93	1934	20.3	1965	20.18	1996	20.26
1904	20.36	1935	19.78	1966	20.25	1997	19.82
1905	19.99	1936	20.29	1967	20.08	1998	20.89
1906	20.26	1937	19.94	1968	19.94	1999	21.32
1907	19.98	1938	20.35	1969	20.74	2000	21.07
1908	19.97	1939	20.37	1970	20.82	2001	21.2
1909	19.89	1940	20.62	1971	20.57	2002	21.24
1910	19.86	1941	21.39	1972	19.75	2003	20.77
1911	20.12	1942	20.6	1973	20.45	2004	21.45
1912	20.42	1943	20.45	1974	20.11	2005	20.59
1913	20.03	1944	20.26	1975	19.85	2006	21.28
1914	20.36	1945	19.97	1976	20.11	2007	21.25
1915	20.85	1946	20.89	1977	20.94	2008	21.14
1916	20.25	1947	21.07	1978	20.49	2009	21.55
1917	19.83	1948	20.52	1979	20.31	2010	21.62
1918	20.04	1949	20.3	1980	20.78	2011	21.31
1919	19.92	1950	19.37	1981	20.62	2012	20.72
1920	19.88	1951	20.36	1982	19.94	2013	21.33
1921	20.68	1952	20.43	1983	20.04	2014	20.97
1922	20.45	1953	20.99	1984	20.31	2015	21.17
1923	19.99	1954	20.36	1985	20.65	2016	21.79
1924	20.16	1955	20.34	1986	20.01	2017	21.55
1925	20.27	1956	20.21	1987	20.82	2018	21.87
1926	20.08	1957	19.57	1988	21.24	2019	20.99
1927	19.93	1958	21	1989	20.06	2020	20.81
1928	20.32	1959	20.55	1990	20.8	2021	21.68
1929	20.1	1960	20.29	1991	20.35		
1930	19.94	1961	20.19	1992	20.12		
1931	20.32	1962	20.18	1993	20.82		

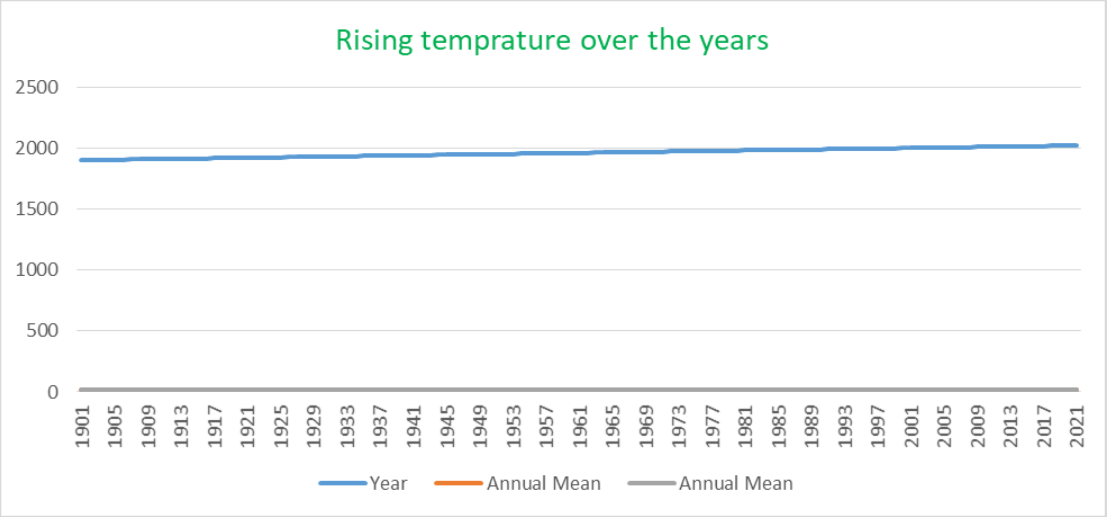

Figure 4.1. rising temprature over the centuary

4.2.1 Graphical Form of Temperature Data

The highest temperature noted in month of January 2009 within last 20 years.

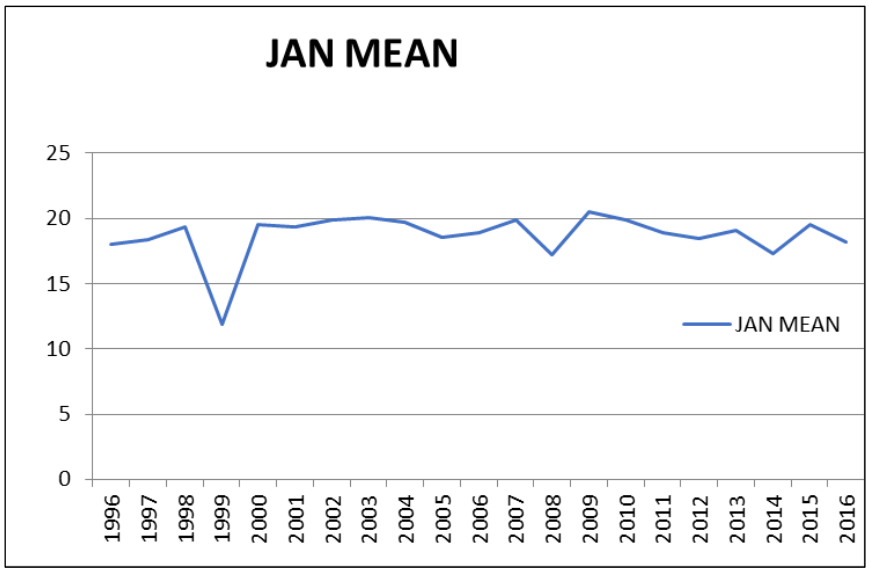

Figure 4.2. jan mean

The highest temperature observed in month of Feb 2006 within last 20 years.

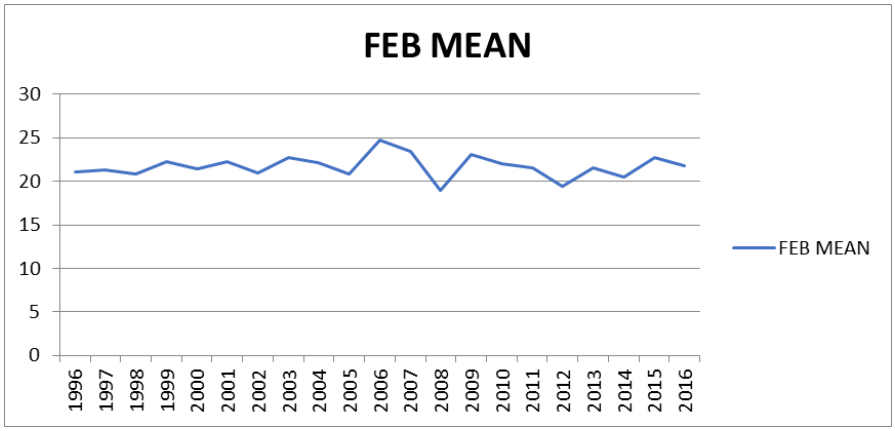

Figure 4.3. feburary Mean

The highest temperature observed in month of March2005 and 2010 within last 20 years.

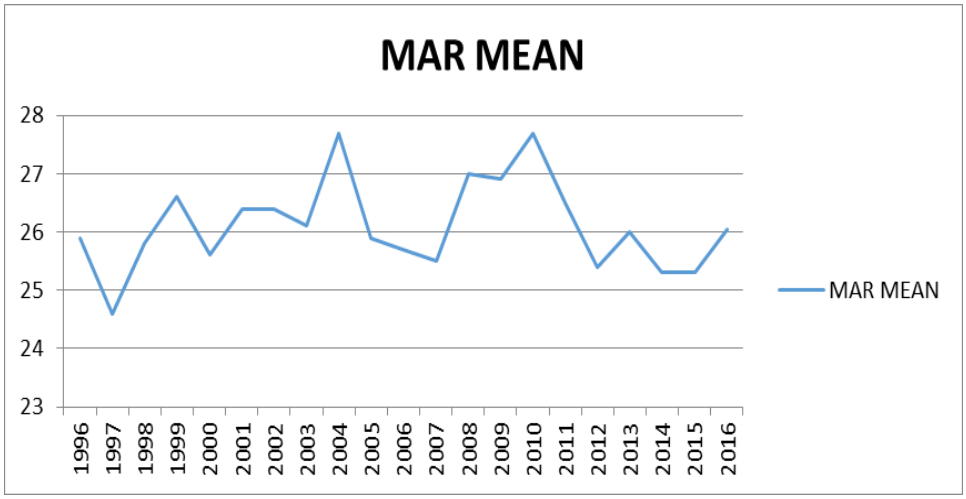

Figure 4.4. March Mean

The highest temperature observed in month of April 2016 within last 20 years.

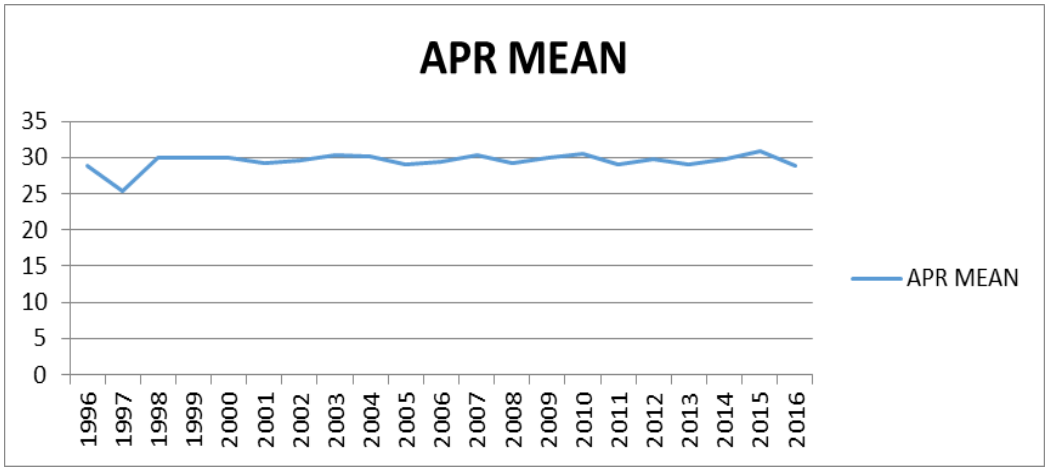

Figure 4.5. April Mean

The highest temperature observed in month of May 2011 within last 20 years

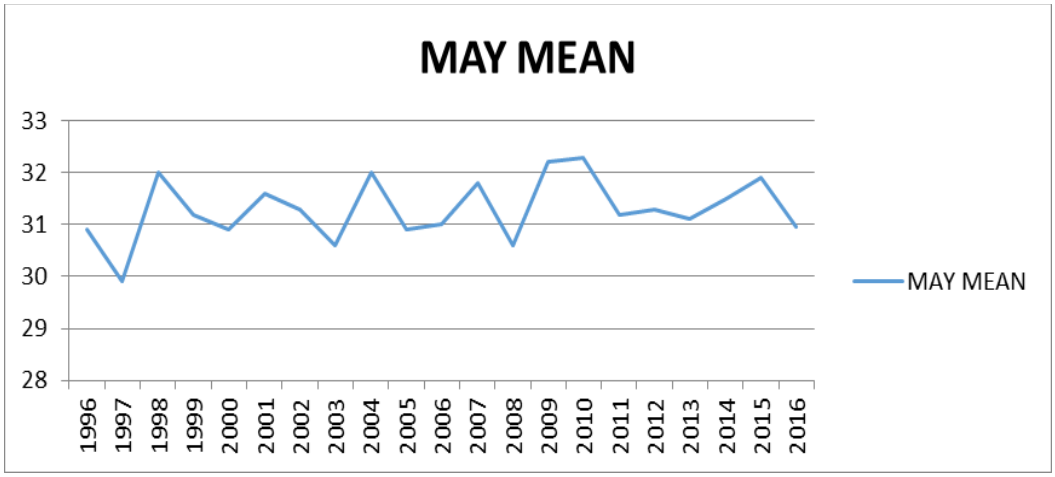

Figure 4.6. May Mean

The highest temperature observed in month of June 2011 within last 20 years

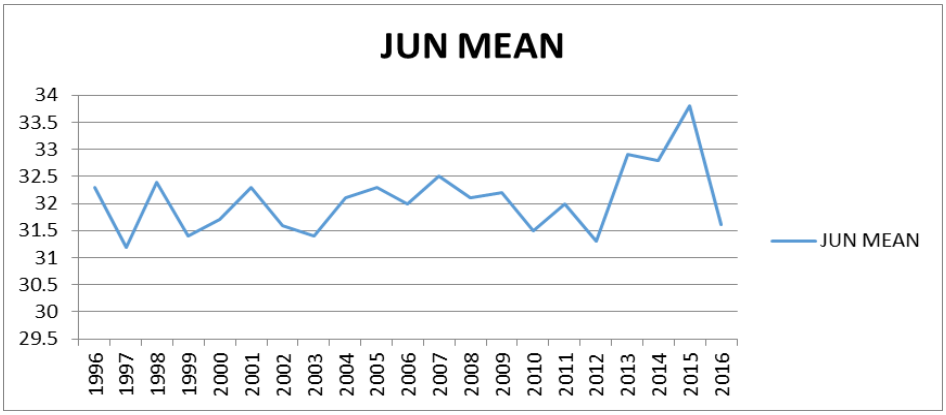

Figure 4.7. Jun Mean

The highest temperature observed in month of July 2011 within last 20 years

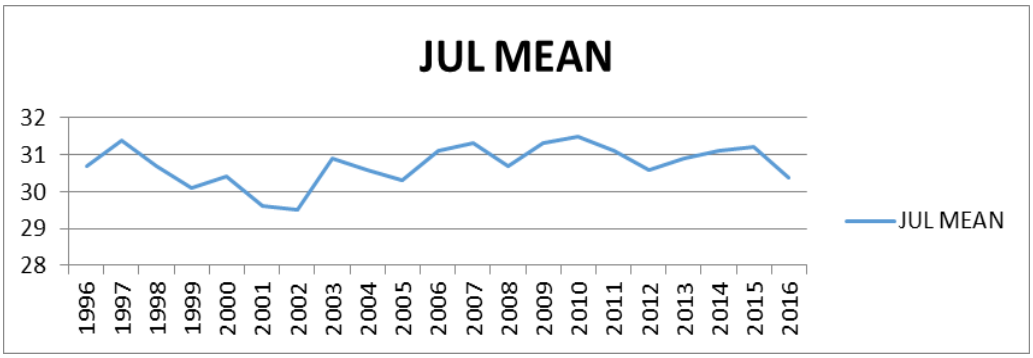

Figure 4.8. July Mean

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The highest temperature observed in month of August 2011 within last 20 years.

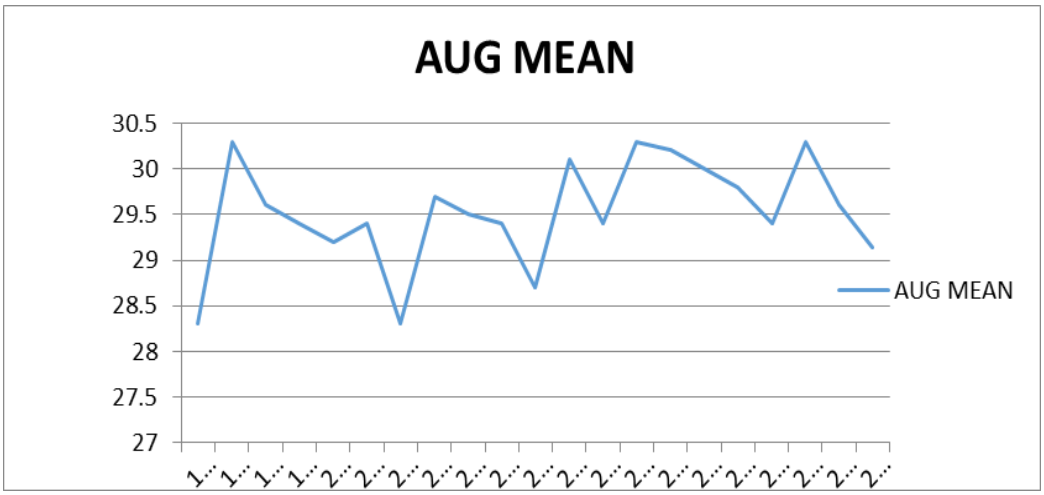

Figure 4.9. August Mean

The highest temperature observed in month of Sep 2011 within last 20 years

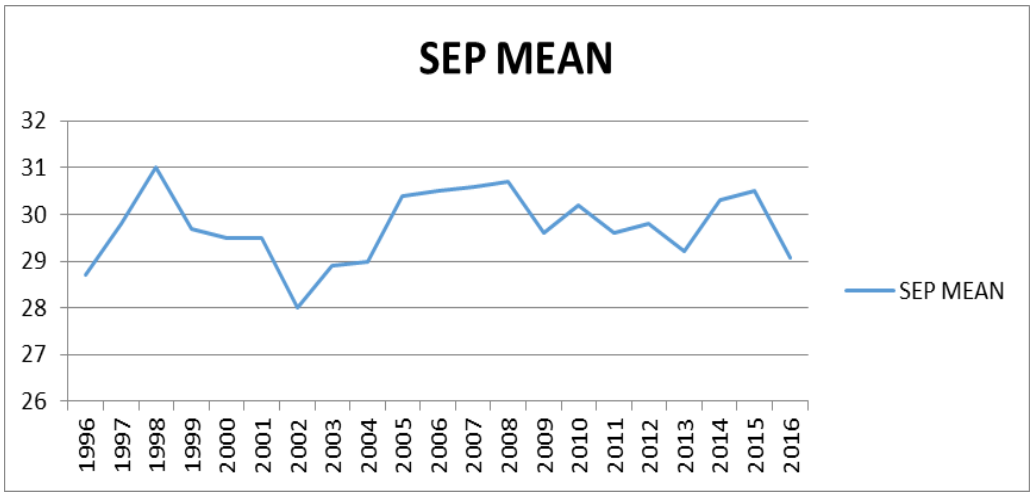

Figure 4.10. September Mean

The highest temperature observed in month of Nov 2011 within last 20 years

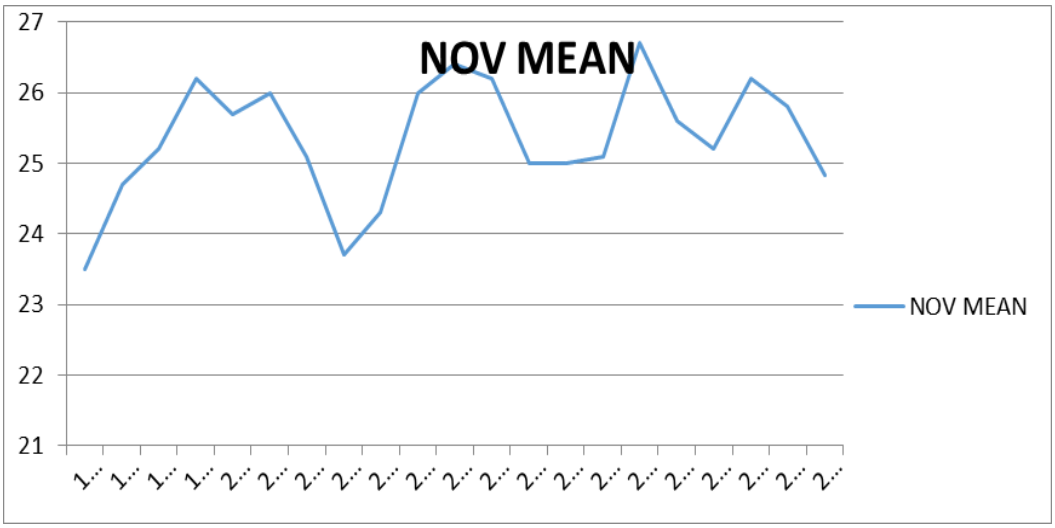

Figure 4.11. November Mean

The highest temperature observed in month of Dec 2011 within last 20 years

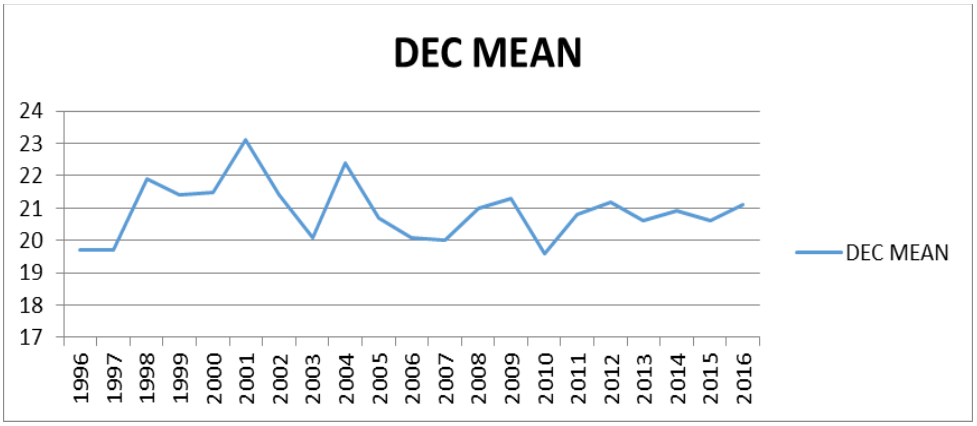

Figure 4.12. December Mean

The highest temperature observed in annually within last 20 years

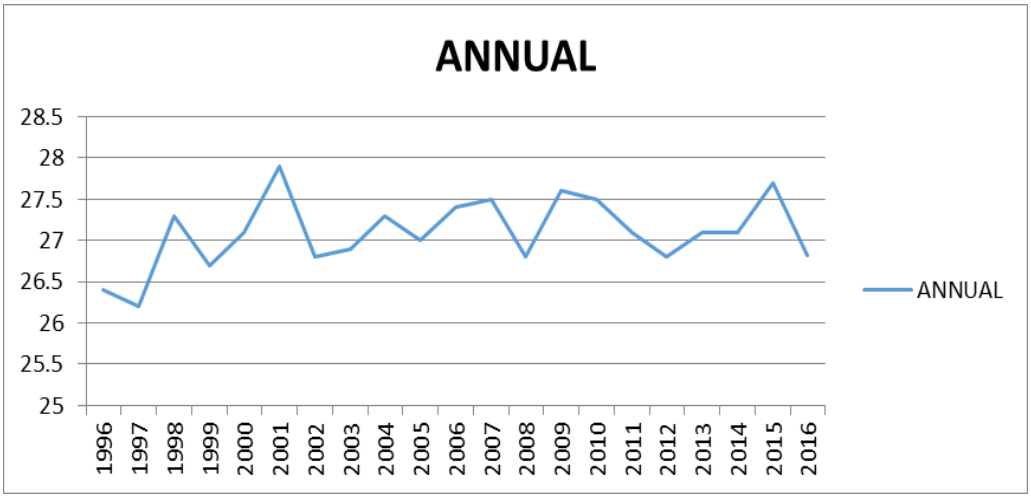

Figure 4.13. Annual Mean

As per graph values, it is to be observed that temperature is gradually increases each duration of study data. Ratio of increasing temperature is in 20 years of data as 1.5°C, as shown in table 4.1. Similarly, we look on self-monitoring data of three years, the ration is increased as 0.4°Cas shown in table 4.2. On base of these increasing values, predicted data which also having increasing ratio of temperature i.e. 0.87°C as shown in table 4.3.

In a 2°C world, an upward push of 0.5 meter is probably to be surpassed by means of about 2070, only 10 years after exceeding this stage in a 4°C global. Through that point, however, the high and occasional scenarios diverge swiftly, with one-meter upward push in a 2°C world now not probable to be exceeded until well into the 22nd century. Sea level upward push refers to the growth inside the imply stage of the oceans. In the context of severe warm occasions, the following recognizance regions are being taken into consideration (Oost et al. 2017):

a) Damage to ecosystems/biodiversity harm to sensitive government installations, residential, commercial and business projects properties.

b) Losses of fishermen communities, sea degree upward, with the aid of himself and in mixture with other coastline hazards, such as excessive storms and the consequences of climate exchange, may have numerous interrelating results.

c) Viable dangers include:

Salt-water intrusion

i. Floods

ii. Typhoon surge

iii. Coastal erosion

d) Climate change will bring further unusual rains to areas near sea, causing runoff and flooding in coastal areas. The case can further worsen the situation with higher temperature on mountains, a major cause of spring run off and increased snow melting. These phenomena result in degradation of health and quality of coastal waters in turn. In some areas coastal areas, are already experiencing "dead zones." Dead zones occur when land-based sources of pollution (e.g., agricultural fertilizers) contribute to algal blooms. When the algae sink and decompose, the process depletes the oxygen in the water.

e) With rising temperature sea waters have warmed in recent times, and this trend is likely to continue in the future. This rising temperature will be a source of further and drastic changes in coastal ecosystems and will show its visibility of flora and fauna of the coastal water.

f) Heating of coastal waters trigger noticeable change on natural habitats of temperature-sensitive species to shift their habitat. Pollock, halibut, rock sole, and snow crab in Alaska and mangrove trees in Florida are a few of the species whose habitats have already begun to shift. Suitable habitats of other species may also shift, because they cannot compete for limited resources with the southern species that are moving northward.

g) Average sea degrees were growing round the arena at some stage in current a long time, however with tremendous nearby version. The common charge of upward push improved from 1.8mm in stepup in the time between 1961 and 2003 up to 3.1mm in keeping with time among 1993 and 2003. Sea-degree

upsurge is an extreme difficulty for coastal towns as growing water ranges and typhoon surges can reason assets harm, dislocation of citizens, interruption of wetland and transportation Damage.

h) Tropical cyclones are climate patterns which might be associated (although the science is not always certainly conclusive) with feasible growing of sea floor temperatures and consequent sea stage upsurge. These patterns are associated with thunderstorms and winds characterized with the aid of their wind move patterns and a nicely definite center ensuing in storm and waves surges (i.e. Brief offshore upward thrust of water) which can harm belongings and threaten the security of societies and bio-diversity inside the affected vicinity.

4.2.2 Drought

Dry spell is caused because of less precipitation during a season or year, which may be not exactly expected annually. Dry seasons could either be fast or extended. Reasonable overseeing of water resources, in expressions of gathering the source and call for opening can considerably diminish the suitable inconvenient impacts of a dry spell upon us and at the environmental factors.

As study region in Karachi, metropolitan inhabitants got around 90% of water from public water supply line through the main public water provider I) Karachi Water and Sewerage Board (KW&SB) ii) KW&SB by means of lines or through vessels and the just 10% of people remove the ground water. Water at little pressure through controlling and in most extreme segments of the town water is conveyed one time or two times seven days, on each event eventually of various hours. The extent of non-income water (NRW) is incredible because of holes (decade old design), taking and an unacceptable person of deals grouping. In most extreme segments of the metropolitan, residents are revealed to put resources into building their own underground water stockpiling, supporter attractions siphons, additional space offices and water filtration plants. The unassuming charge of diverted supply line water in

Karachi can be sensibly assessed; the connected sideways expenses are nonsensically high. The cost of defiled wellspring of drinkable water is compound through the inflexible therapeutic bills in view of the cure of water-borne sickness, (for example, hepatitis, and cholera, typhoid and so on) and the misfortunes in benefits as a result of pitiful time (Dawn, 2017).

Five thick regions in Karachi busy with in excess of 5 million residents are dependent on the Hub stream water resulting the dry spell time that is 1999-2003, while Massive issues were gone up against in highest point the water stresses of the pompous occupant. Nonetheless, the KW&SB began a mass inventory pipeline associating with Dhabiji supply to the siphoning station at Manghopir (A dissemination source from the Hub dam supply to the city), so that, during the lack of water in Hub waterway, the water convey from the Indus source might be diverted to scared regions. By the by, the progression of time even the Indus waterway getting is additionally water focused and didn't satisfy the current need, the oversupply separated from Indus my not be imaginable goal in the drawn out track however demand is unsurprising to development altogether. The financial blueprint of a greater part of the general populations of the transporter part would moreover region them in a vulnerability setting (KWSSIP, 2017).

As talked about, Karachi as of now faces a lopsided population increment because of immigration and numerous different reasons, the tension on assets prompting consumption. Also, the precipitation occasions are shrinking and the impacts of a plausible dry spell term may be extraordinary. Nonetheless, the capability of the provider organization to fulfil the feasible worries can be a superior motivation behind trouble. Money related assertions of KW&SB for current years recommend an extremely upsetting as worries its minor financial circumstances. KW&SB has continually been running in disparity. These shortfalls have at last been supported by utilizing state and nearby legislatures. To perspective the inverse extreme challenges being taken care of through the KWA&SB in articulations of specialized, control limitations and a more prominent obtrusive calamity of coordinated authority would require a discrete look at in him (KWSSIP, 2017).

The action to water collecting and initiating the water preservation, especially rainwater protection through dykes and spring re-energize both the non-perpetual

stream arrangement of metropolitan. Malir stream framework delivered since long a portion of the extremely indispensable sand and rock material purposes in development. It is seen that the waterway existing bowl has now been uncover up to a proportion of 20 ft. In a couple of areas, the bowl is disposal has contacted to an unsafe stage come up to 30 feet. The seawater interruption from the coast can likewise turn into a difficulty in which beach front subsurface water quantity diminishes due to over extraction and it additionally diminished the re-energize and increment in interruption as well as ocean level vertical push. In 2004, KW&SB find the chance of creating groundwater sources in the bowls ofLayari, Gadap, Hub and Malir, to expansion of the overarching water supplies. After the overview and examination, it was reasoned that the acceptable yield of surface water turned out to be beforehand in solidness with the ebb and flow siphon discharge around great many wells and it became extreme to expand new wells (Hasan, 2019).

4.2.3 3D Graphical Form of Drought Data

3D graphical data obtained from PMD showing annually impacts of drought in Karachi City.

As same as 20 years back data obtained which is showing great increasing impacts of drought due to less rainfall. In addition, on the base of these impacts, data has been further valued with the addition of average mean of 20 years back data. As a result, predicted data is derived and added. This data further based on 05 years as can show in each 3D figure according to month wise. The following 3D figures are showing the annual drought future pattern:

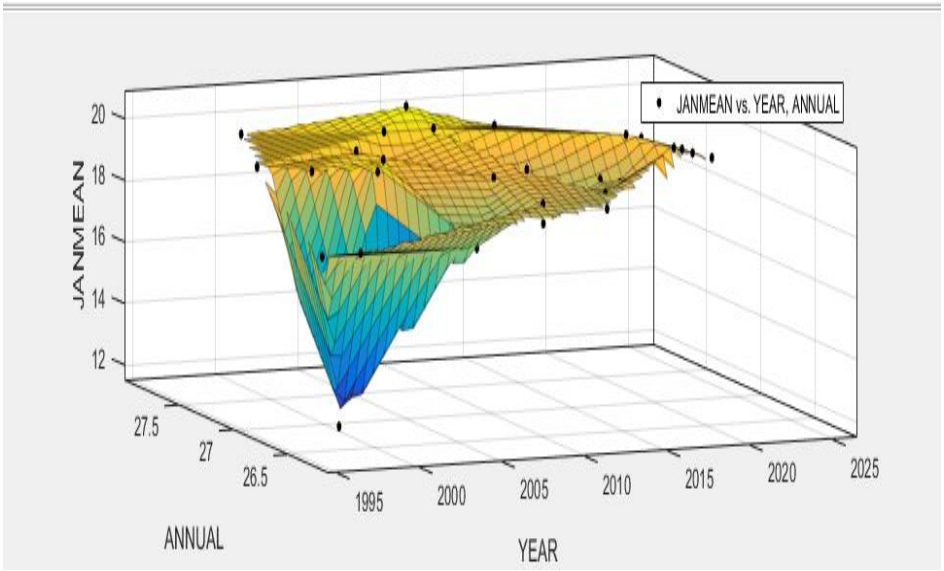

Figure 4.14 3D Annual of January

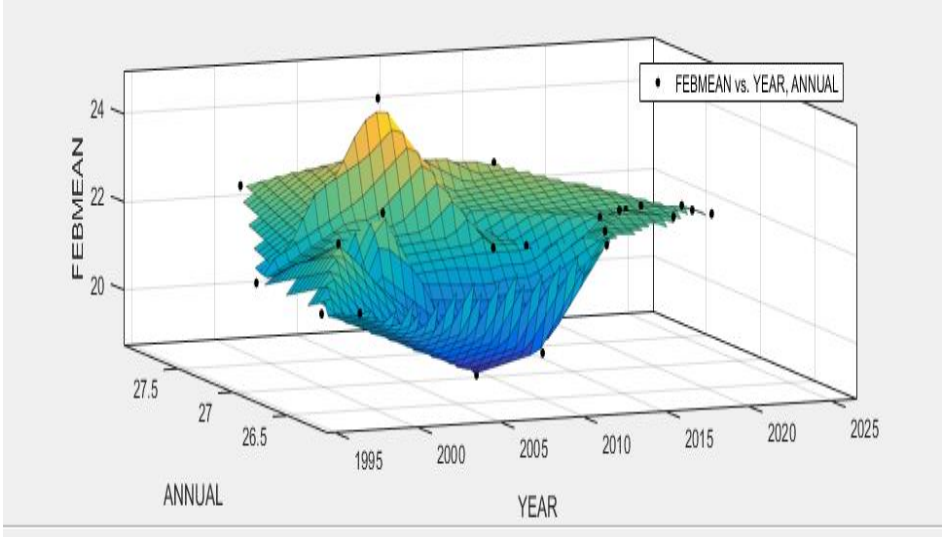

Figure 4.15Mean annual february3D

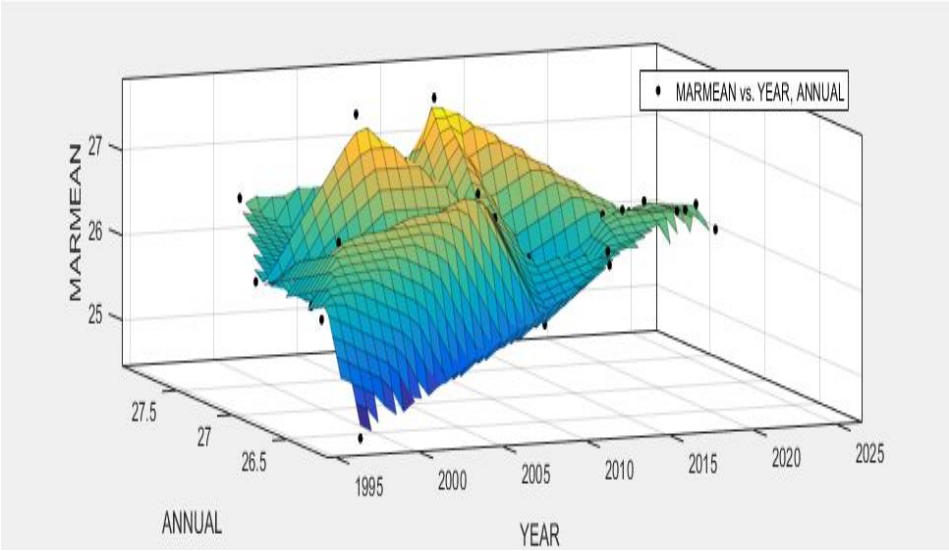

Figure 4.16 mean annual march 3D

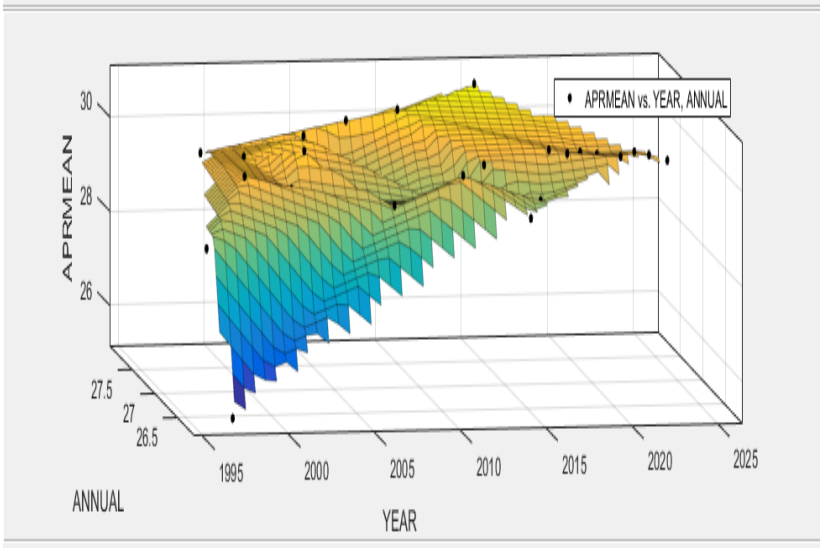

Figure 4.17. April mean annual 3D

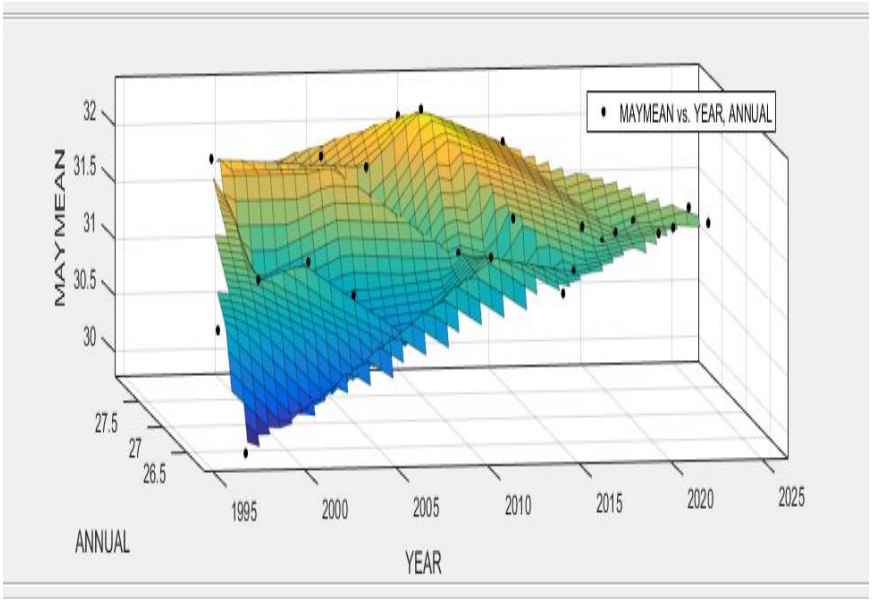

Figure 4.18.Mean annual May 3D

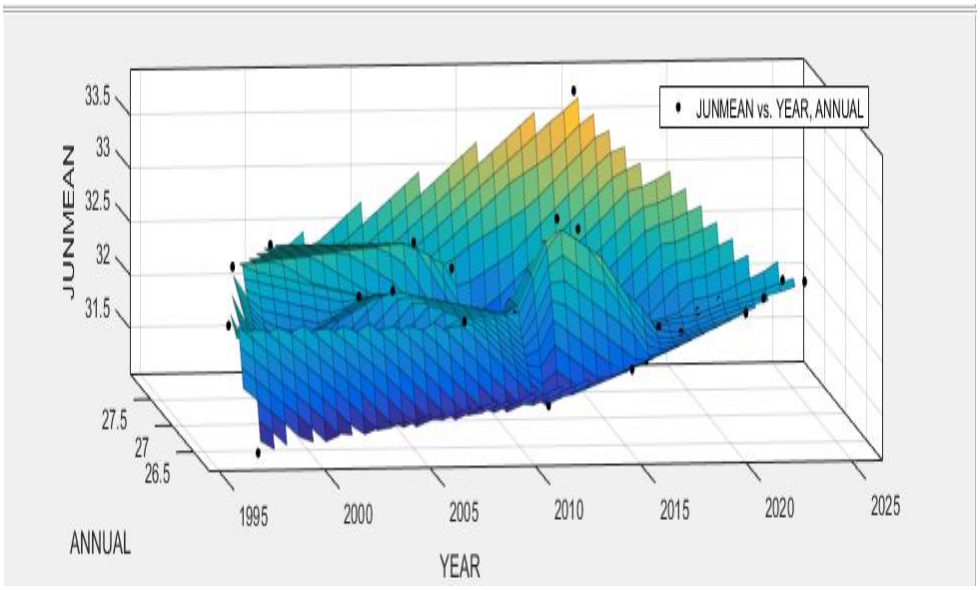

Figure 4.19. Mean annual Jun 3D

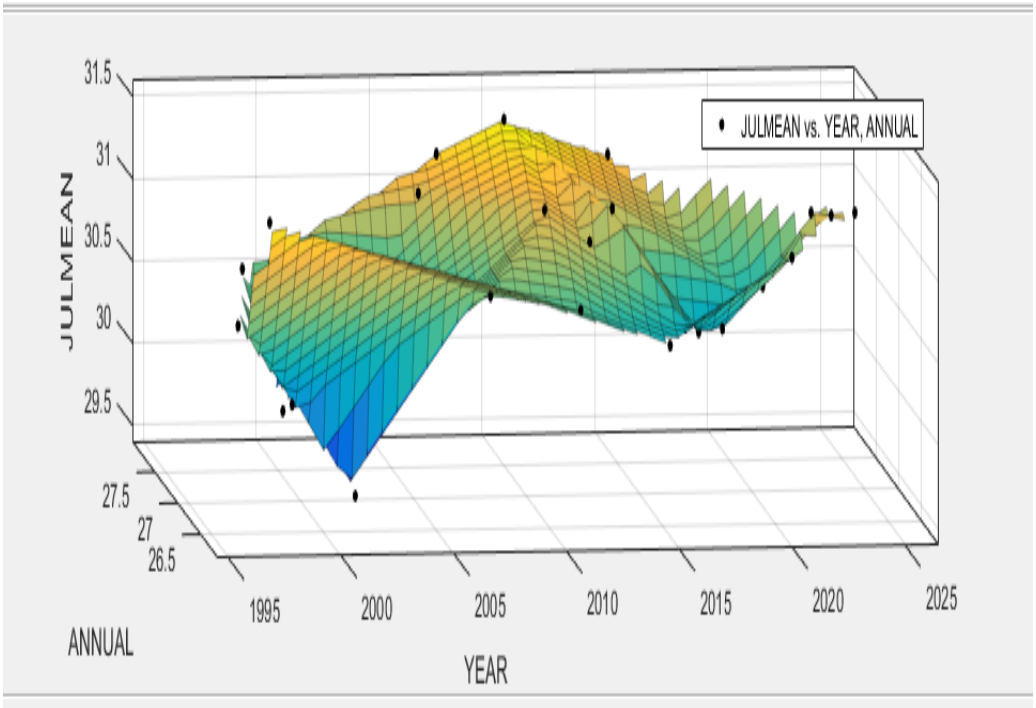

Figure 4.20.Mean Annual Jul 3D

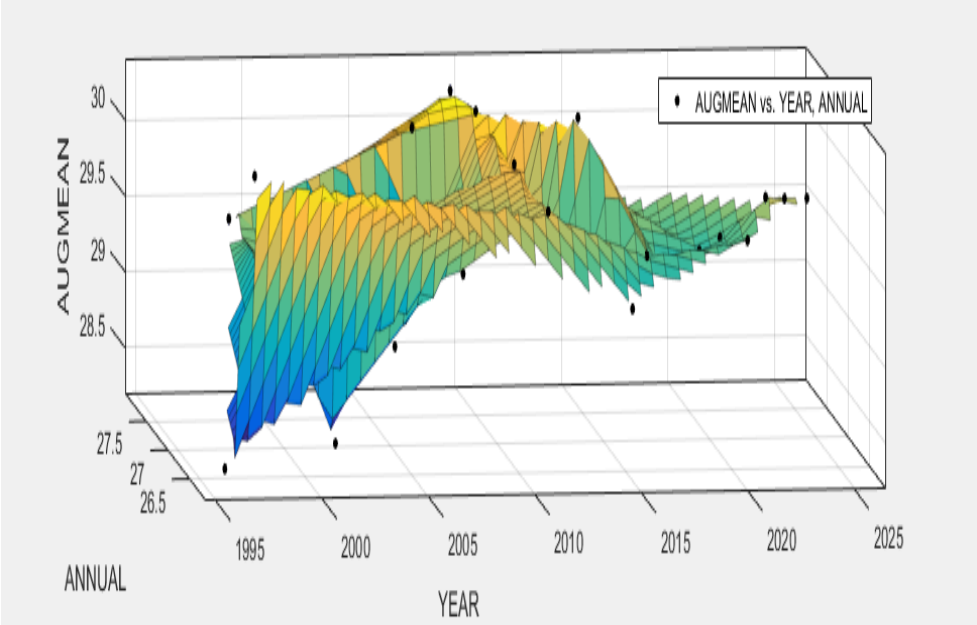

Figure 4.21. Mean annual August 3D

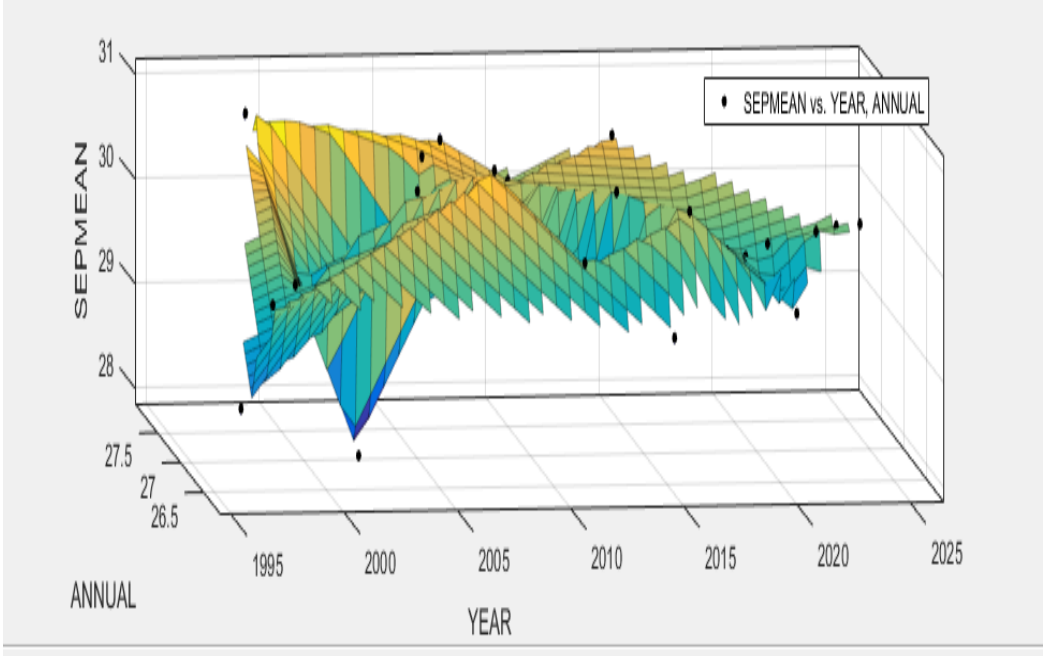

Figure 4.22.Mean annual Sep 3D

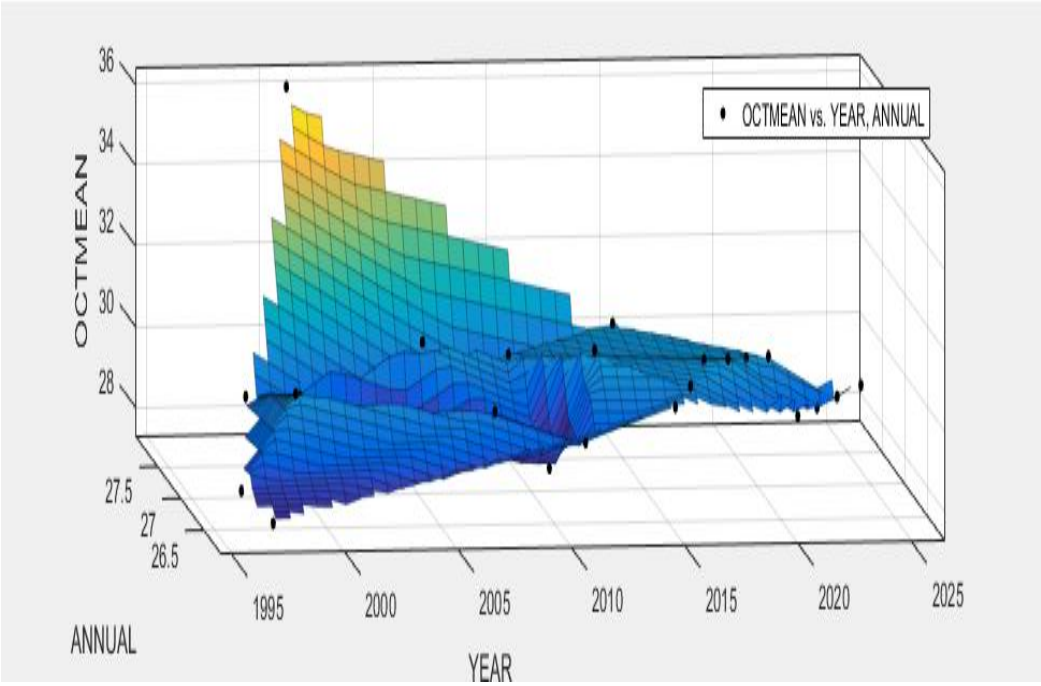

Figure 4.23.Mean annual October 3D

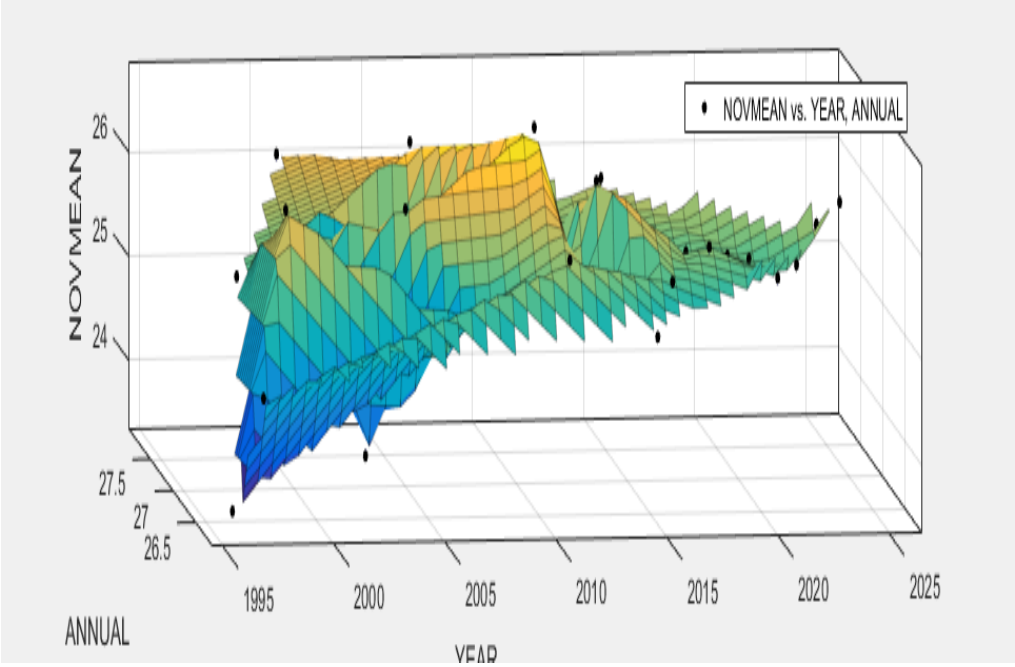

Figure 4.24.Mean annual November 3D

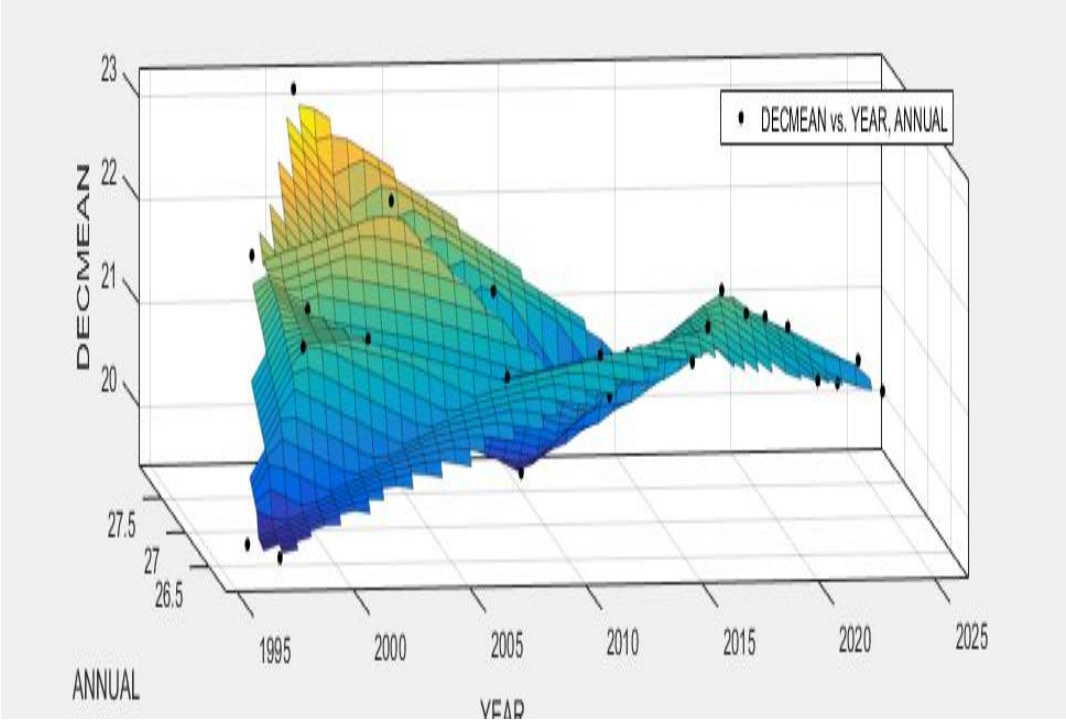

Figure 4.25.Mean annual December 3 D

4.2.4 Heat Wave

Pakistan a serious have heat wave (temperatures as high as 40°C to 45°C) because of moistness levels running 40% to half hit southern Pakistan. Passing's was about multiple thousand from drying out and warm stroke for the most part affected Sindh region and its Capital city, Karachi. Zoo creatures lives and innumerable agrarian animals too. During this occasion in adjoining India, the passing's were 2,500 in May 2015. Temperatures began to grasp Pakistan's southern regions on last seven day stretch of June 2015 and top was on 20 June. Chief General of the Pakistan Environmental Protection Agency Asif Shuja (previous) asserted that hotness wave side effect was of around the world change and bothered by deforestation and quick urbanization. He kept up with, "There has been an ascent in the world's normal temperature from 15.5°C to 16.2°C in the course of the most recent 100 years, because of which we are encountering such outrageous weather patterns both in summers and winters. He likewise says that the absence of complex climate expectation innovation in Pakistan added to the losses from the hotness wave. The hotness wave profile is displayed in figure-1 (Nergis et al., 2017).

Karachi has a parched environment, albeit a moderate variant of this environment. Karachi is situated on the coast and accordingly has a generally gentle environment. Karachi has two principle seasons; summer and winter, while spring and fall are exceptionally short. Summer season endures for longest period during the year. Karachi likewise gets the downpours from July to September. The city partakes in a heat and humidity incorporating warm winters and blistering summers. The moistness levels as a rule stay high from March to November, while exceptionally low in winter as the breeze heading in winter is northeasterly.

Environment ordinarily characterized as the weather conditions found the middle value of over an extensive stretch. The standard averaging period is 30 years; different periods might be contingent upon the reason. Environment likewise incorporates insights other than the normal, for example, the sizes of everyday or year-to-year varieties (IPCC) 2001.

4.2.5 Heat waves Data

The accompanying Heat waves (Maximum Temperature of the day/pinnacle of Temperature) information and charts of long term (1996-2025) of Karachi displayed in Table-3 and figures 16-29.

As same as 20 years back information got which is showing incredible expanding effects of Heat waves because of dry season, less precipitation and high temperature. Moreover, on the foundation of these effects, information has been further revalued with the expansion of normal mean of 20 years back information. Thus, anticipated information is determined and added.

Table 4.5. Mean Monthly Maximum Temperature (°C) (1996-2025)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1996	27	29.3	32.5	34.9	35.4	35.9	33.8	31.1	32.2	35	30.8	27.9	32
1997	25.5	28.6	30.6	32.1	34.4	34.5	34.1	33.2	33	32.3	30.7	26.1	31.3
1998	26.1	27.5	32.3	35.4	36.6	36	33.4	32.5	35.3	35.6	33	29.2	32.7
1999	26.2	28.7	34.8	36.2	35.2	34.5	28	32.4	32.8	36.7	33.2	29.1	32.3
2000	26.4	28.1	32.6	35.4	34	34.8	33.2	32.2	32.9	35.9	32.5	29.2	32.3
2001	27.2	29.6	33.1	34.6	35.1	34.8	32.1	32.3	33.1	36	33.5	30.4	32.6
2002	27	28.2	33.3	35.4	35.6	35.1	32.2	31	31.3	36.5	32.7	28.1	32.2
2003	27.6	28.5	32.3	36.6	35.7	34.8	34.1	33.5	32.5	37	32.2	28.3	32.8
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.5	32.6	32.8	33.7	30.7	29.4	32.8
2005	24.9	26.2	31.4	35.2	35.4	36.1	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26	31.3	31.8	34.3	34.6	35.4	33.9	31	34.2	35	33.4	26.3	32.3
2007	26.8	29.4	31.3	36	36	36.3	34.7	32.8	34.5	35.9	33.9	27.1	32.9
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32
2009	26.2	29.8	33	36	36.8	35.7	34.5	33	32.8	35.9	33	28.6	32.9
2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33
2011	26.9	28.5	33.3	34.8	35.3	35.2	34.3	33.1	32.7	33.2	33.1	28.8	32.4
2012	25.7	26.9	31.7	35.1	35.5	34.6	33.2	32.7	33.2	35	32.7	28.2	32
2013	26.7	28	33.3	34	35.1	36.5	33.8	32.1	33	35.7	32.3	28.3	32.4
2014	25.5	28	31.7	35.1	35.9	36.5	34	33.7	33.8	36.3	32.9	28.7	32.7
2015	26.3	28.9	31.5	35.9	36	37.7	34.1	32.3	34.6	35.8	33	28.6	32.9
2016	26.2	28.8	32.9	34.9	35.2	34.9	32.5	32.1	32.9	35.2	32.1	28.3	32.2
2017	26.4	28.6	32.9	35.0	35.2	34.8	32.5	32.4	33.2	35.3	32.5	28.4	32.3
2018	26.5	28.6	33.3	35.6	35.5	35.1	32.4	32.2	33.3	35.9	32.9	28.8	32.5
2019	26.5	28.8	33.4	35.5	35.3	35.0	32.5	32.2	33.0	35.9	32.8	28.7	32.5
2020	26.6	28.8	33.0	35.3	35.3	35.2	33.6	32.3	33.1	35.7	32.7	28.5	32.5
2021	26.5	28.8	33.0	35.3	35.6	35.4	33.6	32.3	33.2	35.6	32.8	28.3	32.5
2022	26.4	28.6	33.0	35.4	35.7	35.5	33.9	32.4	33.3	35.5	32.6	27.9	32.5
2023	26.2	28.7	32.9	35.4	35.7	35.6	34.1	32.6	33.7	35.3	32.6	28.0	32.6
2024	26.0	28.7	33.0	35.1	35.7	35.7	34.0	32.4	33.9	35.0	32.7	28.0	32.5
2025	25.9	28.5	32.3	35.1	35.4	35.7	33.9	32.3	34.0	35.4	33.1	27.8	32.4

4.2.6 Graphical Form of Heat waves Data

Heat waves Data also represented in graphical form to show impacts of it on climate. Data is showing highly impacts of heat waves as can be seen in below tables.

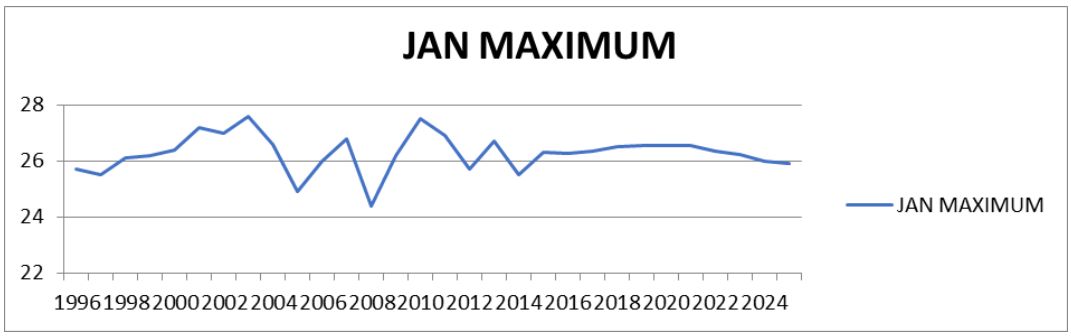

Figure 4.26.mean monthly maximum temperature (°c) January (1996-2025)

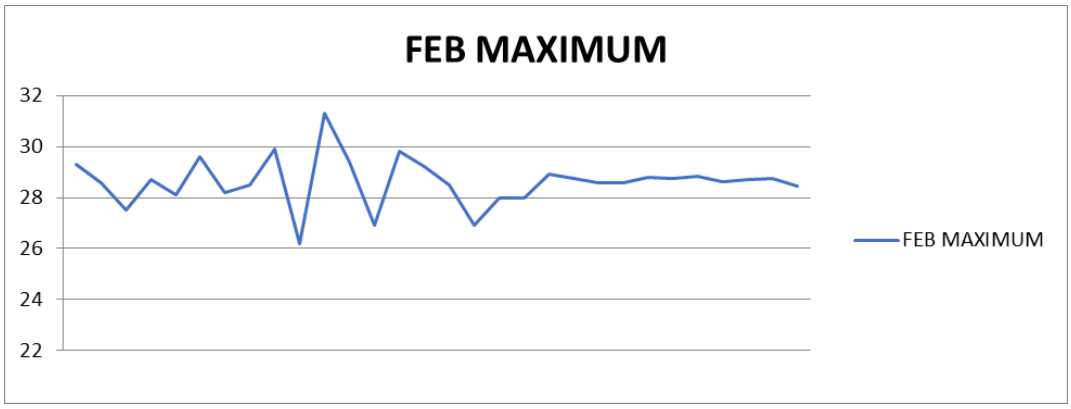

Figure 4.27.mean monthly maximum temperature (°c) Feburay (1996-2025)

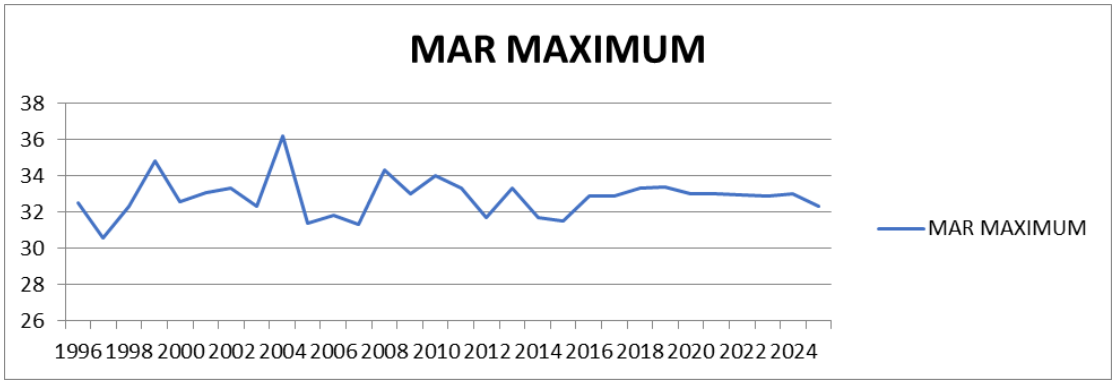

Figure 4.28. March Maximium

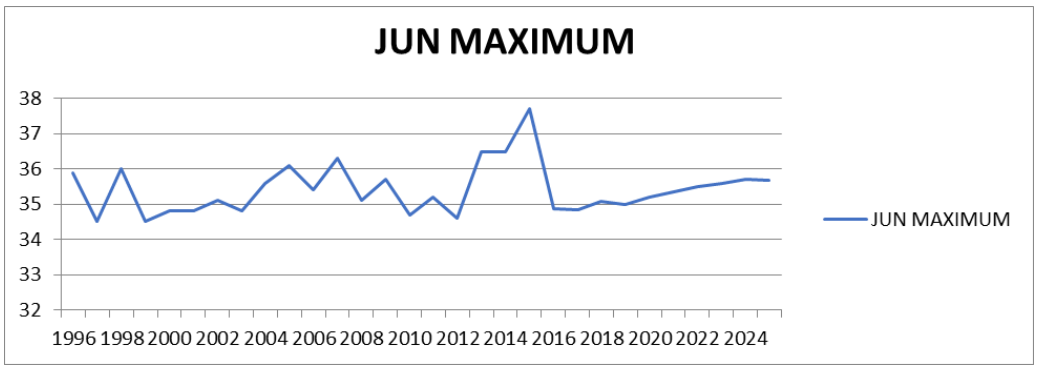

Figure 4.29. Jun Maximium

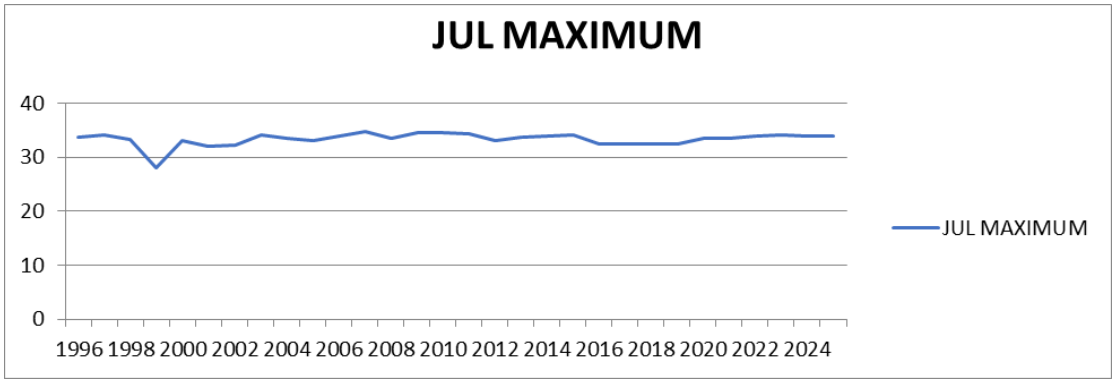

Figure 4.30. July maximium

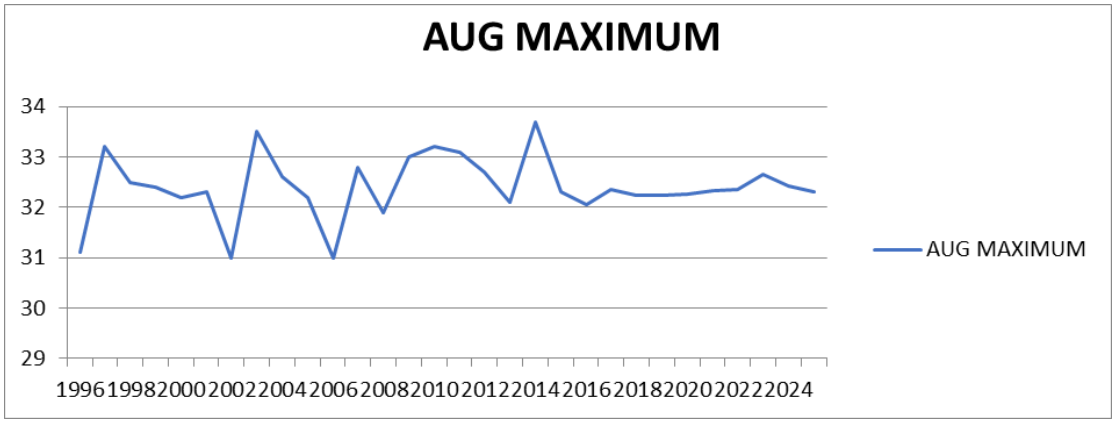

Figure 4.31. August Maximum

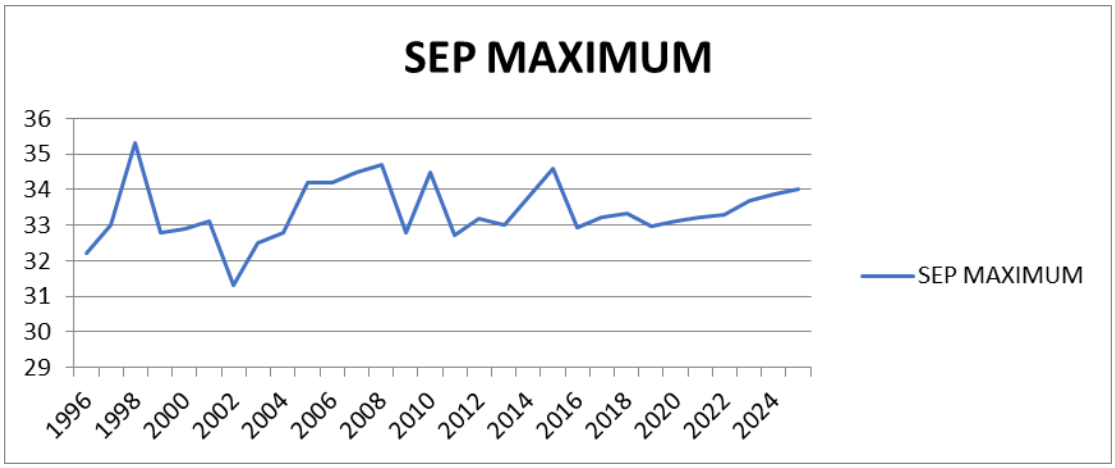

Figure 4.32. September Maxmium

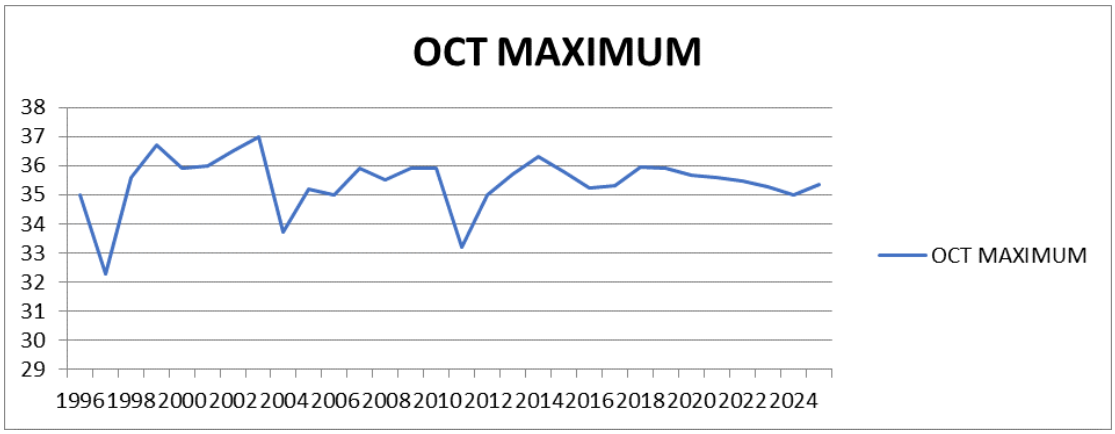

Figure 4.33. October Maximium

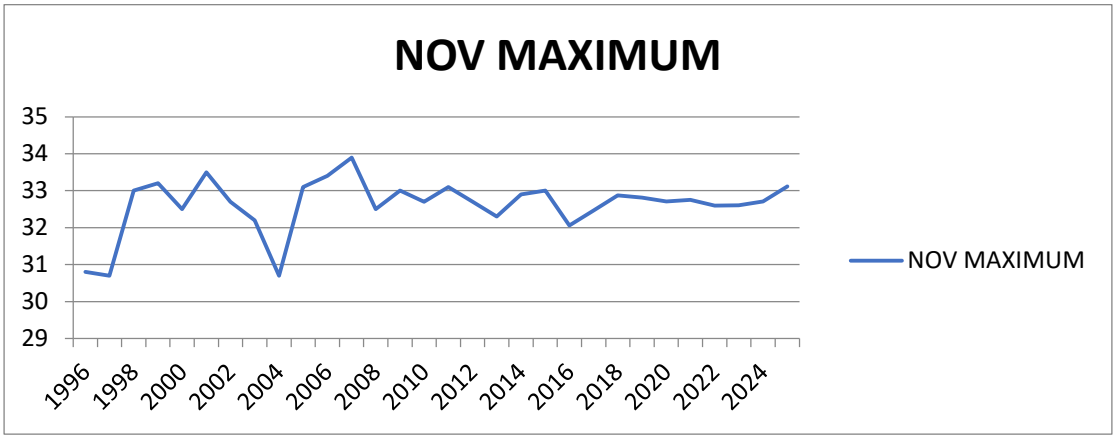

Figure 4.34. November Maximium

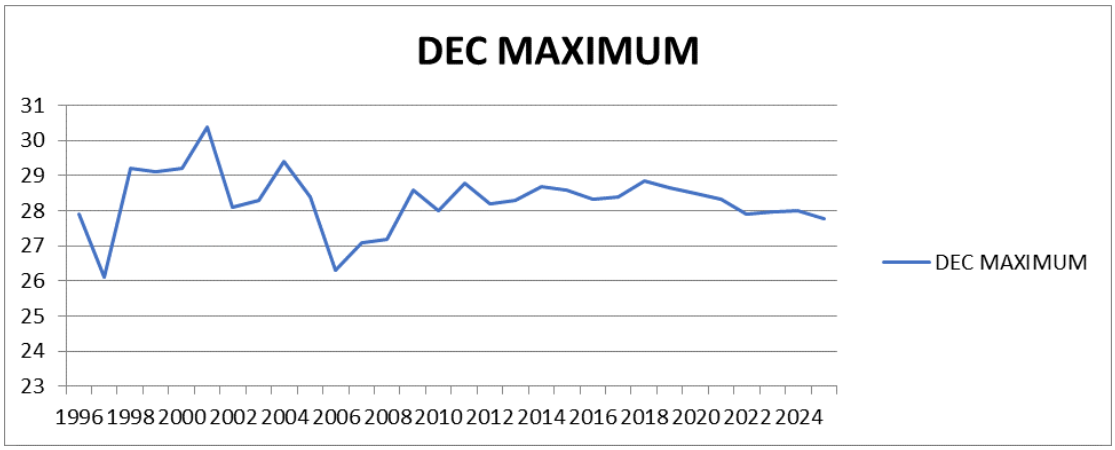

Figure 4.35. December Maximium

Following factors are in city increase in Karachi, which could contribute or are already contributing to elevating the temperature degrees in the metropolis because of human actions.

4.3 Floods

The purpose of this study is to make cognizance and are expecting threats and possibilities with respect to climate change for Karachi.

In this studies a pass-sectional review of postgraduate apprentices turned into performed at Jinnah postgraduate clinical middle and civil health centre Karachi from 21st-24t July 2007, to assess the preparation and self-diagnosed lacks of medical doctors elaborate in big trauma casualty control. Out of the ninety respondents wondered concerning a self-valuation of their schooling, simplest three (3.3%) of them have been assured approximately their administration of bomb explosion sufferers. 80-seven (96.6%) of the defendants manipulated they requisite some in addition working out (44.4%) or complete education (52.2%). No replicated drills or guides were performed for catastrophe management inside the emergency branch of the surveyed hospitals. Most of the ambulance drivers had no paramedic education. Ambulances are ready with a stretchers and oxygen cylinder simplest. No resuscitation measures have been found available in the ambulances. An awesome 96% of the medical doctors felt they had been poor of their training and management of such situations. Notwithstanding availability of verbal exchange between am balances of the same organisation, no conversation hyperlinks are to be had among the ambulance offerings and supposed hospices. With respects fire facilities, and assessment ended these days via Muhammad Masood Alam, municipal services executive district officer of metropolis Karachi district government inside the framework of susceptibilities and risks of Karachi and training of District catastrophe Strategy 2011, is understandable:

i. No fireplace Hydrant system at some stage in the town is existing
ii. Non-providing of education on global well-known
iii. In accessibility of hearth schooling institute
iv. Non application of safety regulations
v. Critical scarcity of water for fire fighting motive

vi. Lack of hearth combating body of workers

vii. Scarcity of hearth station

viii. Absenteeism of collaboration of different corporations on scene of incident

ix. Lack of unique hearth fighting gadgets snorkel, hazmat rescue gadgets and ambulances.

4.3.1 Table Form of Floods Data

As same as 20 years back data obtained which is showing great increasing impacts of floods due to drought, less rainfall and high temperature and make cause of climate change. In addition, on the base of these impacts, data has been further revalue with the addition of average mean of 20 years back data. As a result, predicted data is derived and added. This data further based on 05 years as which can show also in each graphical figure according to month wise.

Table 4.6/ Mean Annual Precipitation (mm) (1996-2025)

Annual Mean Precipitation (mm)	
Year	Annual
1996	99
1997	150.1
1998	82.4
1999	14.5
2000	46.9
2001	100.4
2002	55.8
2003	324.9
2004	65.9
2005	97.2
2006	301.1
2007	465.6
2008	121.6
2009	279.9
2010	372.9
2011	290.2
2012	152.1
2013	168.9
2014	30.7
2015	53.2
2016	111.7
2017	129.1
2018	135.0
2019	153.6
2020	184.9
2021	209.1
2022	222.4
2023	245.1
2024	214.4
2025	237.0

4.3.2 Graph Form of Floods Data

Flood Data also represented in graphical form to show impacts of it on climate. Data is showing highly impacts of heat waves as can be seen in below tables.

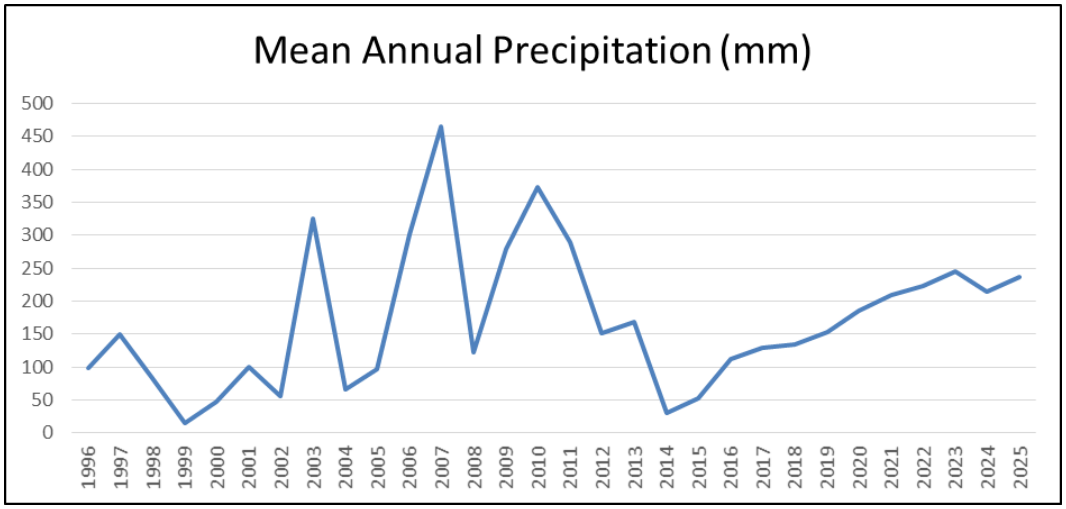

Figure 4.36. Mean Annual

As mentioned above, Climate collectively based on air quality, being air is initial component of climate. As we know that air present in atmosphere depend on composition of different elements. These elements change and disturb by the two types of activities, i.e. natural activities and anthropogenic or human activities. Its sources have tremendous impacts on air pollution, which make cause of climate change. Being study of impacts of climate change, there is also important to study and analyses air quality of study area. For this purpose, we study air quality of our study areas through focusing the variation of elements of air and pollutants, which make cause of air pollution, and as a result, we face the big change in climate. Therefore, secondly data is to relate air quality. For this purpose, air monitoring conducted (self-monitoring) of study areas in which different pollutants are studied which produced by anthropogenic activities.

Regarding this study following pattern surveyed as presented data showing values in their respective units. On base of their values, data analysed, discussed and formulated the impacts on climate changes. This Study focuses on a emissions of air pollutants as abovementioned as CO, NO_2, SO_2 and Particulate Matters (TSPM, $PM_{10,}$ $PM_{2.5}$) in main four industrial zones of Karachi city, emphasizing on air quality because of direct emissions, impacts on climate change. Air quality monitoring conducted in two durations of seasons like Pre-Moon Soon and Post-Moon Soon.

Table 4.7. Major Industrial Zones in Karachi

MAJOR INDUSTRIAL ZONES	DESCRIPTION
Sindh Industrial Trading Estates (SITE)	SITE recognized by the Government of Sindh in the year 1947 in order to endorse industrialization and produce attractive circumstances for industrialists. There are more than 2000 industrial units on 4500 acres (1800 ha) of land west of the Lyari River. The town grew as worker colonies established around the industrial estate. The industrial area comprising textile, steel, pharmaceutical, automobile, chemical, engineering, beverage and flourmills.
Korangi Industrial Area	Established in mid 60s and made operational in 1970. It spread over an area of 8500 acres. Korangi Industrial Area houses approximately 3000 facilities for various industries including textile, steel, pharmaceutical, automobile, chemical, engineering, food and flour mills etc.
Landhi Industrial Area	Landhi Industrial Area established in 1949. It comprises about 11,000 acres (4,500 ha) of land, and consists of medium and large size industries. The industrial area houses many industries including textile, steel, pharmaceutical, automobile, chemical, engineering, and flour mills etc.
North Karachi Industrial Area	It came into existence in 1974. It is scattered and spread over an area of 725 acres, which is a registered more than 2000 commercial, industrial and service units containing automobile, textile, engineering, food etc.

Pollution due to the industrial activity is one of the main sources of ambient air quality deterioration. It has not been conceivable to evaluate the enormousness of industrial air contamination. Industrial releases have enlarged considerably over the previous years. Ambient Air data compared with available Sindh Environmental Quality Standards (SEQS) guideline.

Table 4.8S.I.T.E Area Data

Sampling Site	**Parameters (µg/m^3)**					
SITE Area	**CO**	**NO_2**	**SO_2**	**TSPM**	**PM_{10}**	**$PM_{2.5}$**
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Habib Bank Chorangi	1.12	35	25	394	**168**	**92**
Siemen Chorangi	1.91	40	28	**580**	**192**	**101**
Ghani Chorangi	1.61	42	43	340	**155**	**83**
Valika Road	2.26	47	37	**572**	**178**	**96**
Labour Square	2.13	52	32	417	**160**	**89**
Denim Road	2.38	55	36	317	149	**83**

Table 4.9. North Karachi Industrial Area Data

Sampling Site	**Parameters (µg/m^3)**					
Korangi Industrial Area	**CO**	**NO_2**	**SO_2**	**TSPM**	**PM_{10}**	**$PM_{2.5}$**
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Bilal Chorangi	0.35	51	30	386	***187***	***97***
Vita Chorangi	0.98	30	24	324	148	***81***
Singer Chorangi	1.85	27	38	***567***	***201***	***117***
Murtaza Chorangi	2.12	38	24	***745***	***409***	***238***
Darulaloom Road	0.52	22	26	367	136	64
Shan Chorangi	0.77	42	35	288	138	67

Table 4.10. industrial area

Sampling Site	**Parameters (µg/m^3)**					
North Karachi Industrial Area	**CO**	**NO_2**	**SO_2**	**TSPM**	**PM_{10}**	**$PM_{2.5}$**
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Nagan Chorangi	0.61	64	51	***648***	***292***	***173***
Sohrab Goth	2.89	73	42	***607***	***281***	***166***
Shafiq Morr	1.19	23	31	468	148	73
Godhra Road	3.98	32	30	311	145	72
Sakhi Hassan Chorangi	2.83	22	23	273	129	67
Water pump Chorangi	0.29	22	25	317	137	55

Table 4.11. : Landhi Industrial Area Data

Sampling Site	**Parameters (µg/m^3)**					
Landhi Industrial Area	**CO**	**NO_2**	**SO_2**	**TSPM**	**PM_{10}**	**$PM_{2.5}$**
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Yunus Chorangi	3.58	69	39	***656***	***371***	***198***
Dawood Chorangi	2.12	49	37	***762***	***329***	***197***
LIAR	0.29	32	26	376	***194***	***93***
YB Chorangi FLY	0.92	58	42	294	148	67
Zafar Town	0.59	76	34	262	129	63
Future Morr	1.99	42	39	407	***173***	***98***

4.3.3 Graphical Interpretation of Ambient Air Data of Study Areas in Pre-moon soon

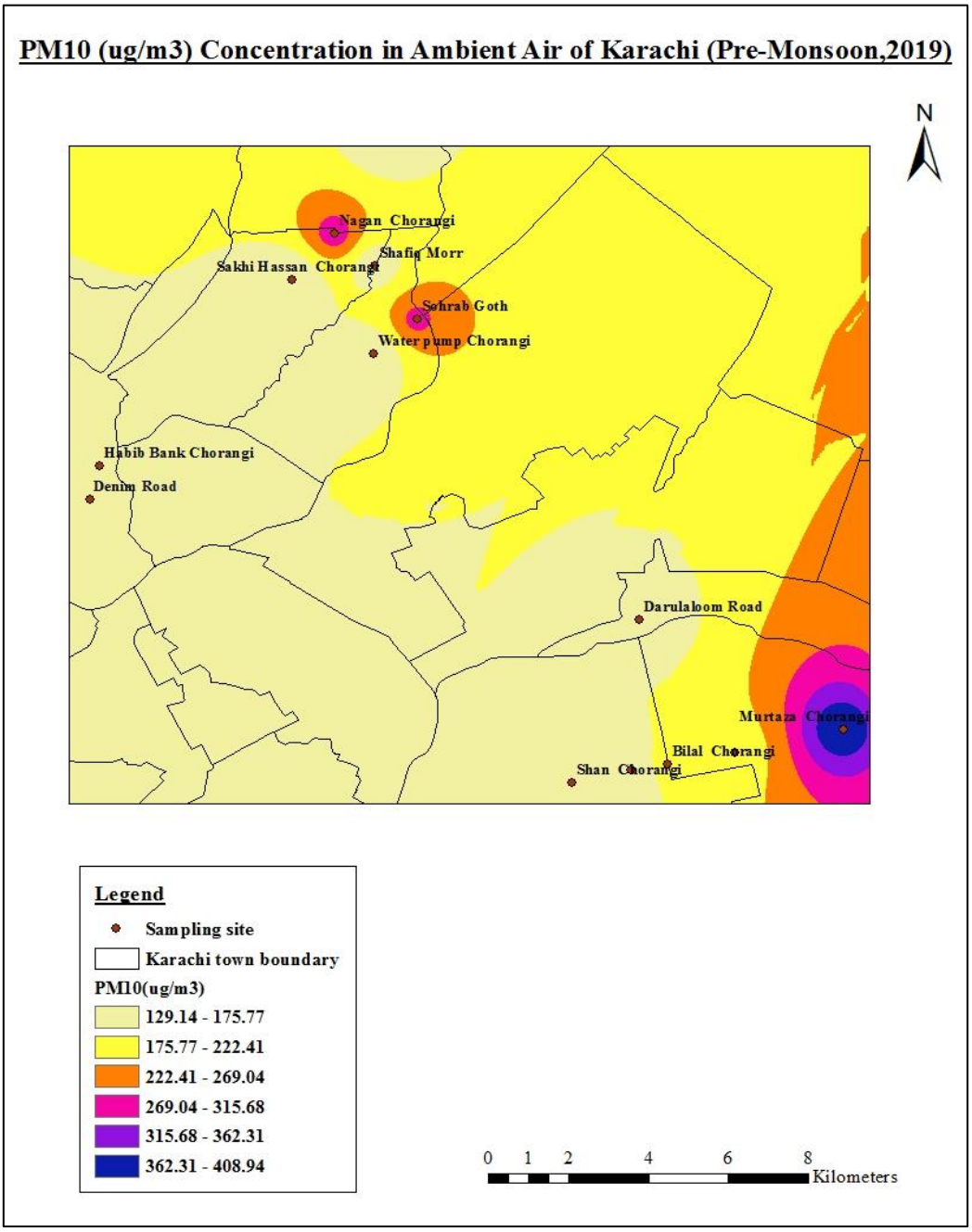

Figure 4.37PM 10 pre moon soon

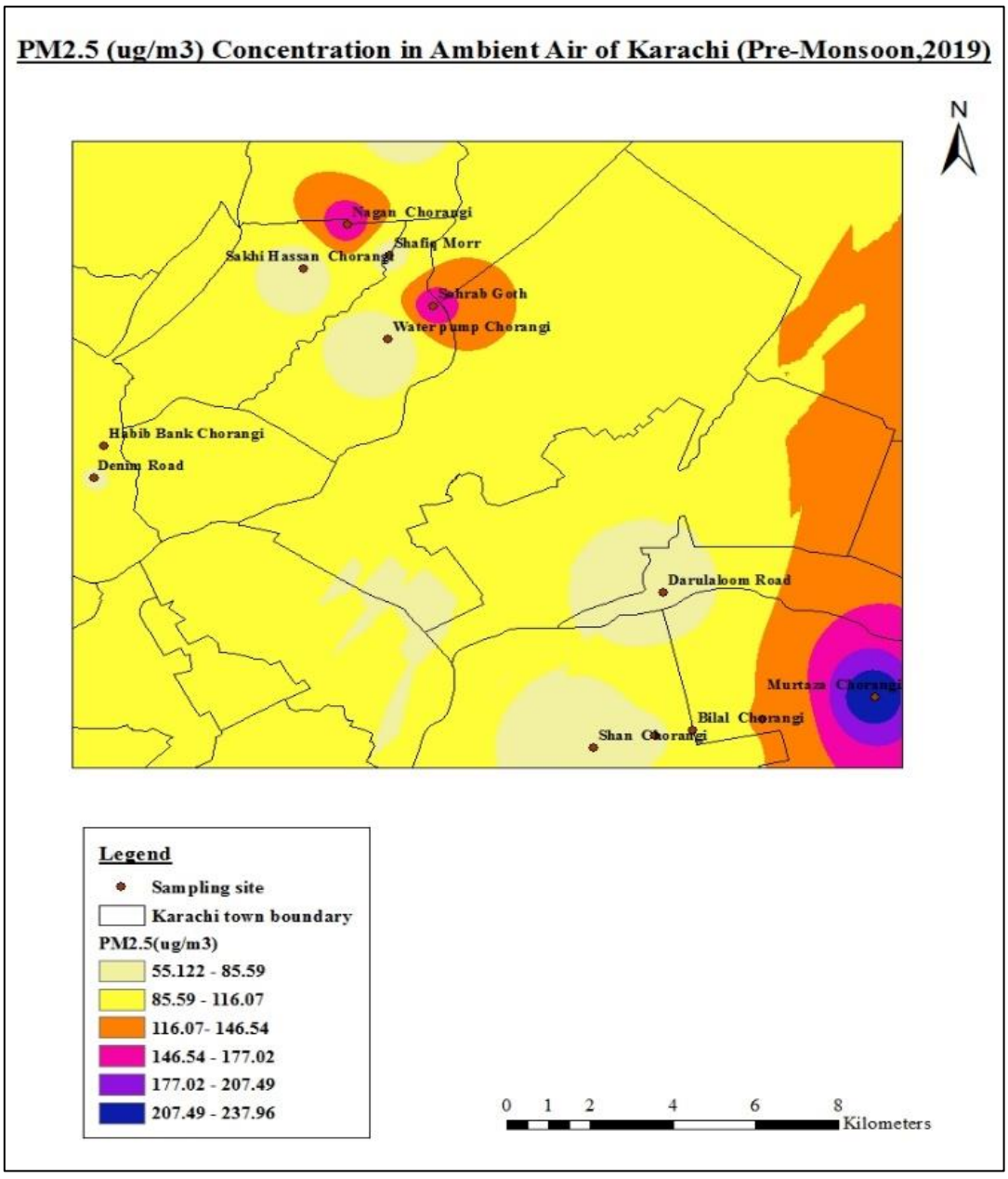

Figure 4.38Figure 4. 1 Pre-Monsoon PM10 concentrations from Four Industrial SITES

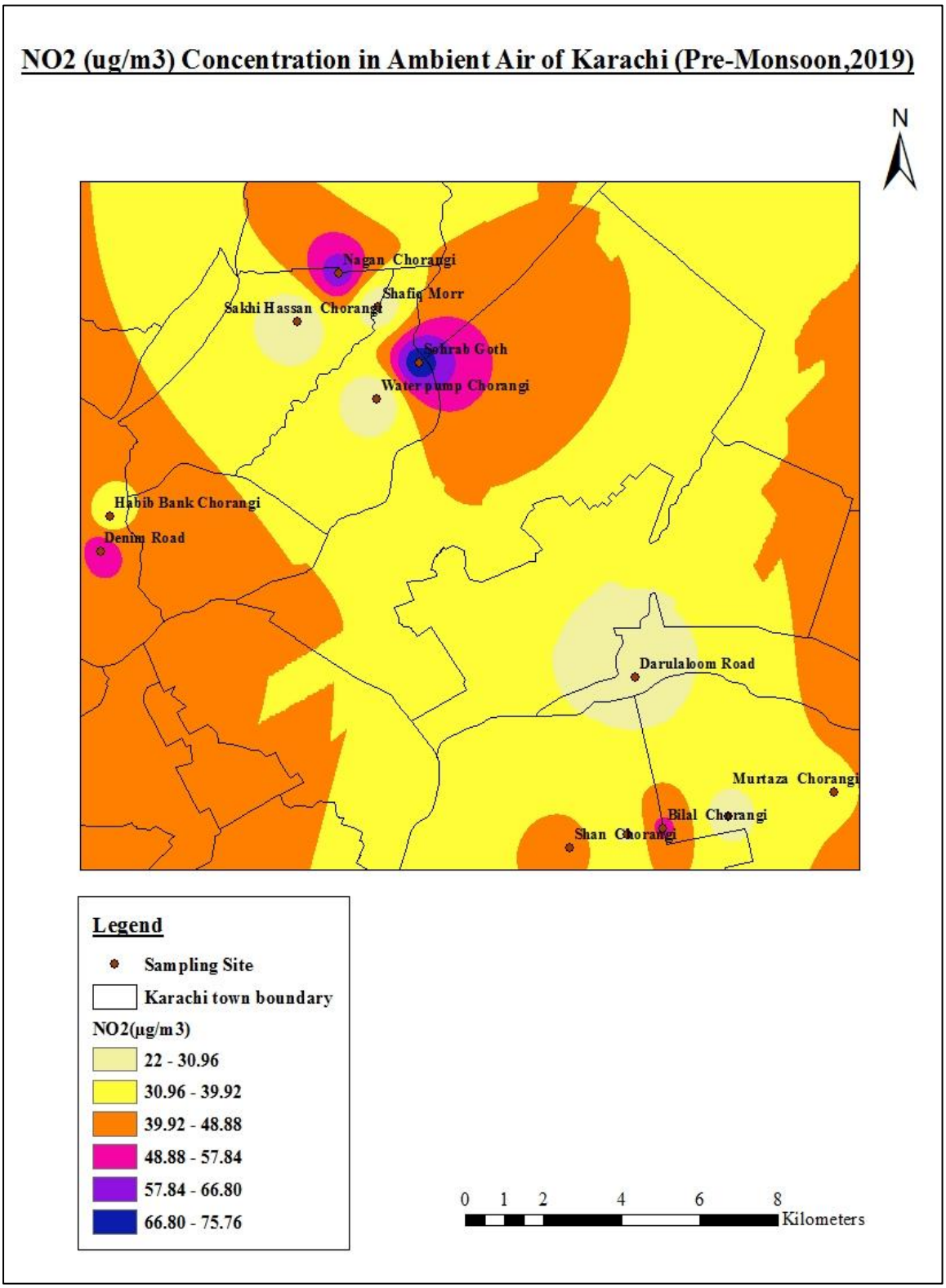

Figure 4.39 NO_2

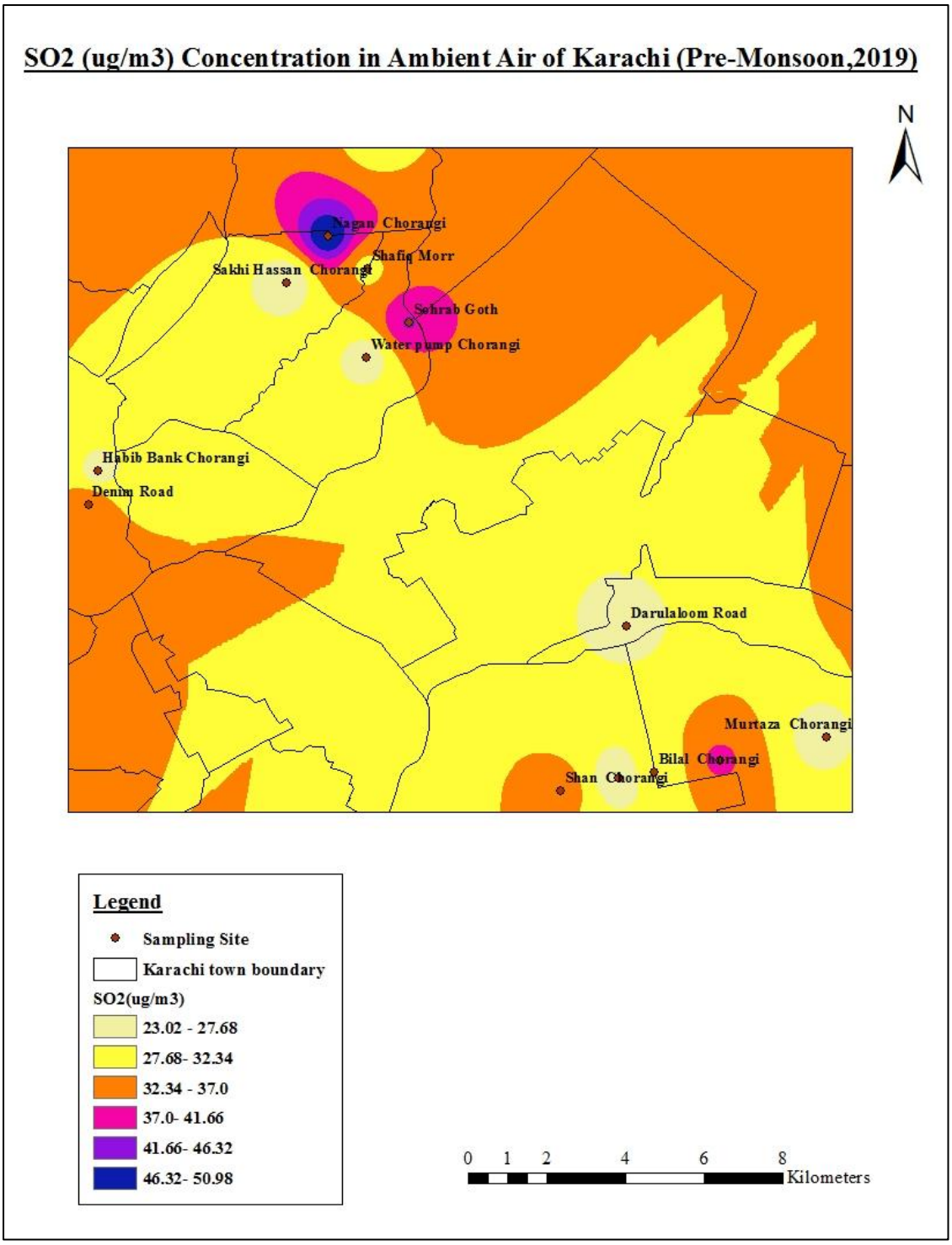

Figure 4.40 SO_2status of the industrial areas

Table 4.12. S.I.T.E Area Data (2017-2019) under line value max for column

Sampling Site SITE Area	Parameters (µg/m³)					
	CO	NO_2	SO_2	TSPM	PM_{10}	$PM_{2.5}$
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Habib Bank Chorangi	1.77	30	29	298	144	67
Siemen Chorangi	1.21	36	24	***514***	***162***	***78***
Ghani Chorangi	1.07	32	35	***531***	***187***	***85***
Valika Road	0.99	28	22	259	142	69
Labour Square	1.14	40	26	260	128	51
Denim Road	1.01	29	28	228	107	42

Table 4. 1: Korangi Industrial Area Dataunder line value max for column

Sampling Site Korangi Industrial Area	Parameters (µg/m³)					
	CO	NO_2	SO_2	TSPM	PM_{10}	$PM_{2.5}$
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Bilal Chorangi	0.30	42	25	272	133	59
Vita Chorangi	2.58	35	23	297	131	70
Singer Chorangi	2.94	46	29	228	113	54
Murtaza Chorangi	3.76	53	37	***514***	***197***	***92***
Darulaloom Road	1.94	42	31	219	103	41
Shan Chorangi	2.34	38	23	201	104	32

Table 4. 2: North Karachi Industrial Area Data under line value max for column

Sampling Site North Karachi Industrial Area	Parameters (µg/m³)					
	CO	NO_2	SO_2	TSPM	PM_{10}	$PM_{2.5}$
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Nagan Chorangi	0.41	41	30	431	145	70
Sohrab Goth	1.27	49	26	***532***	***171***	***95***
Shafiq Morr	0.97	36	20	210	102	56
Godhra Road	2.11	52	25	212	118	49
Sakhi Hassan Chorangi	2.65	25	28	202	112	38
Water Pump Chorangi	0.27	29	19	236	114	32

Table 4. 3: Landhi Industrial Area Dataunder line value max for column

Sampling Site Landhi Industrial Area	Parameters (µg/m³)					
	CO	NO_2	SO_2	TSPM	PM_{10}	$PM_{2.5}$
SEQS	**10**	**80**	**120**	**500**	**150**	**75**
Yunus Chorangi	2.90	60	35	***569***	***212***	***131***
Dawood Chorangi	1.61	36	30	***599***	***226***	***148***
LIAR	0.82	27	21	256	135	63
YB Chorangi FLY	0.51	30	28	209	117	42
Zafar Town	0.77	47	25	237	115	48
Future Morr	1.70	53	31	357	146	66

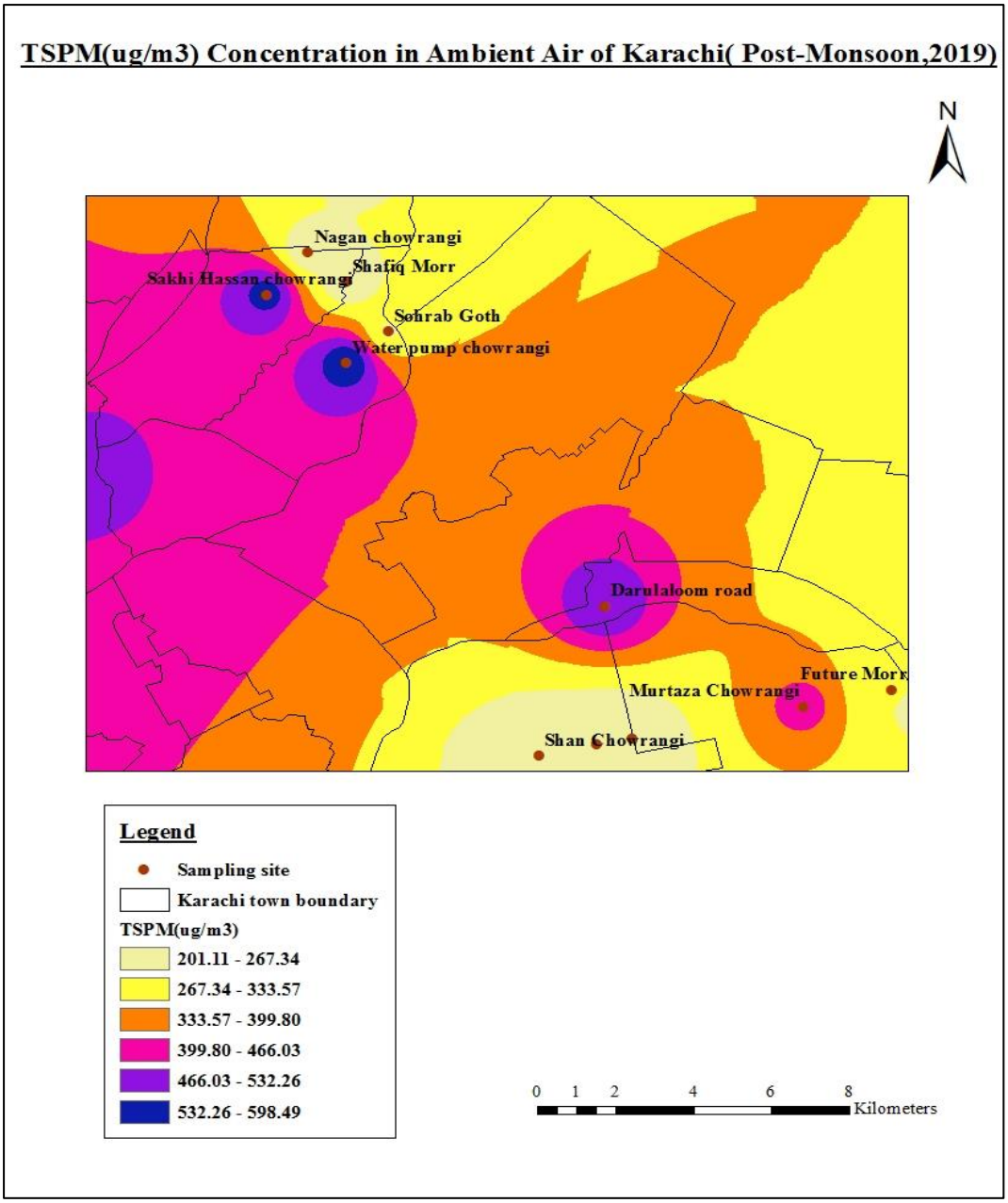

Figure 4.41 post moon soon TSPM in the area

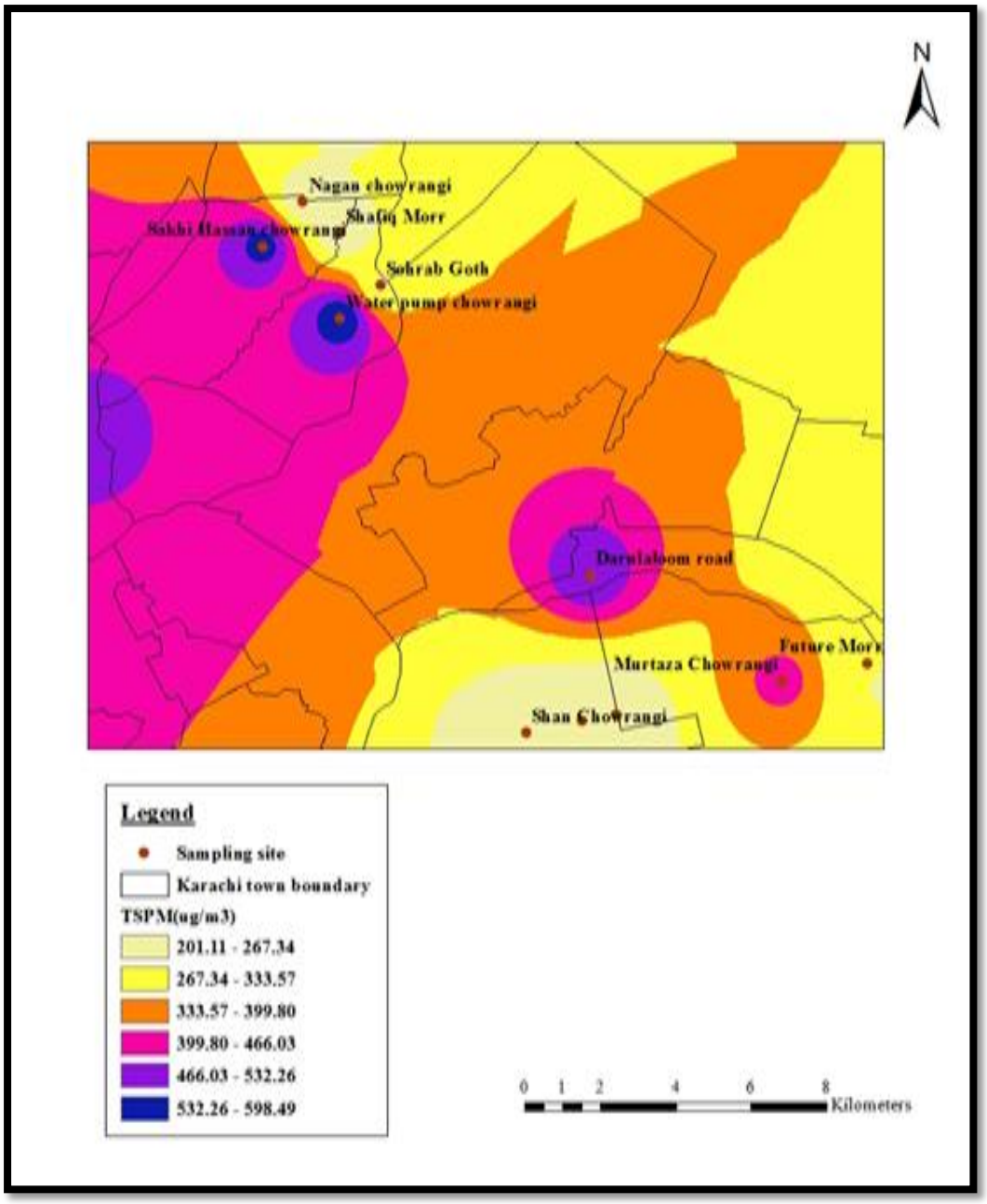

Figure 4.42Post-Monsoon PM2.5 concentrations from Four Industrial SITES

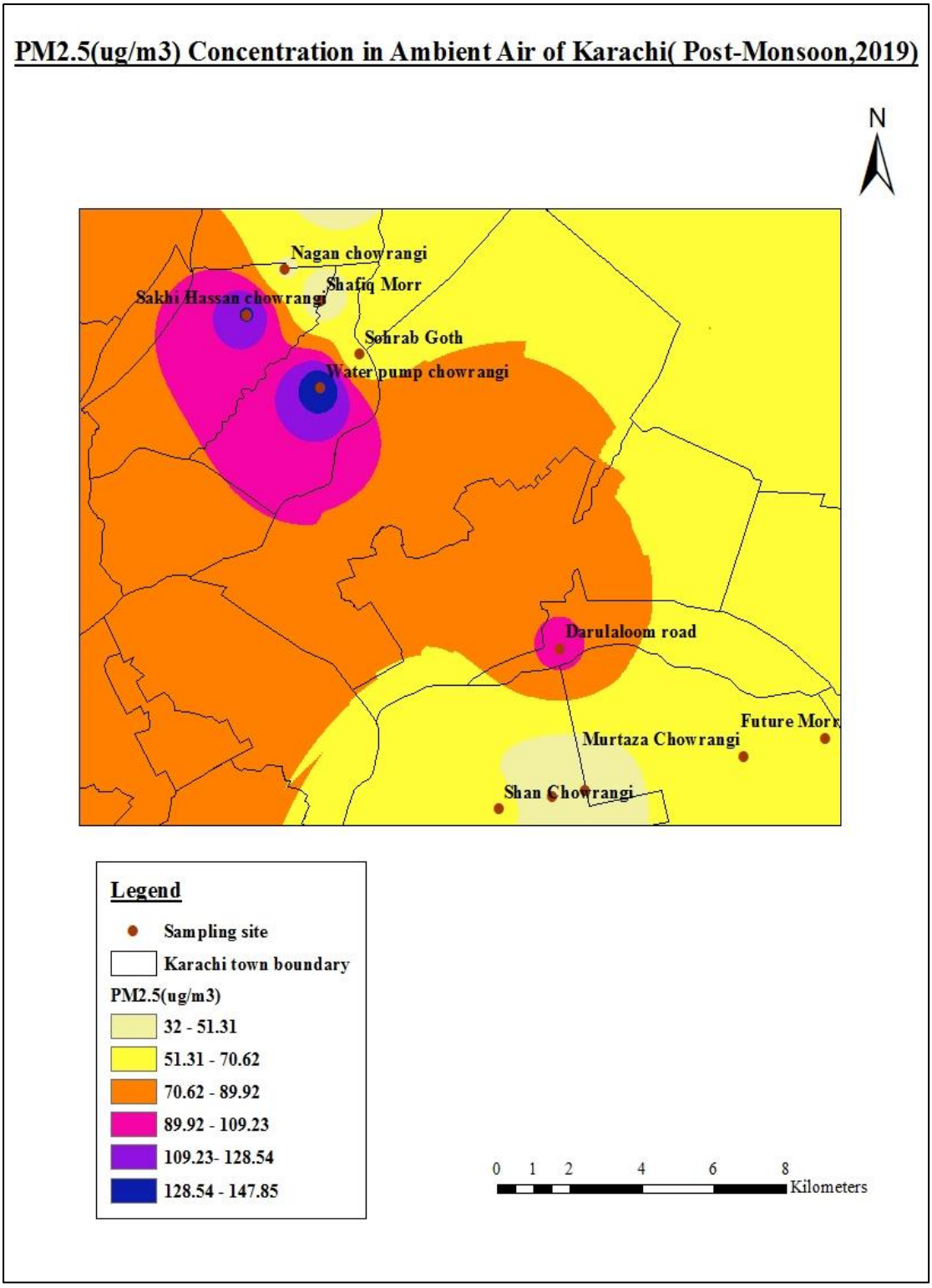

Figure 4.43 post moon soon PM 2.5Post-Monsoon CO concentrations from Four Industrial SITES

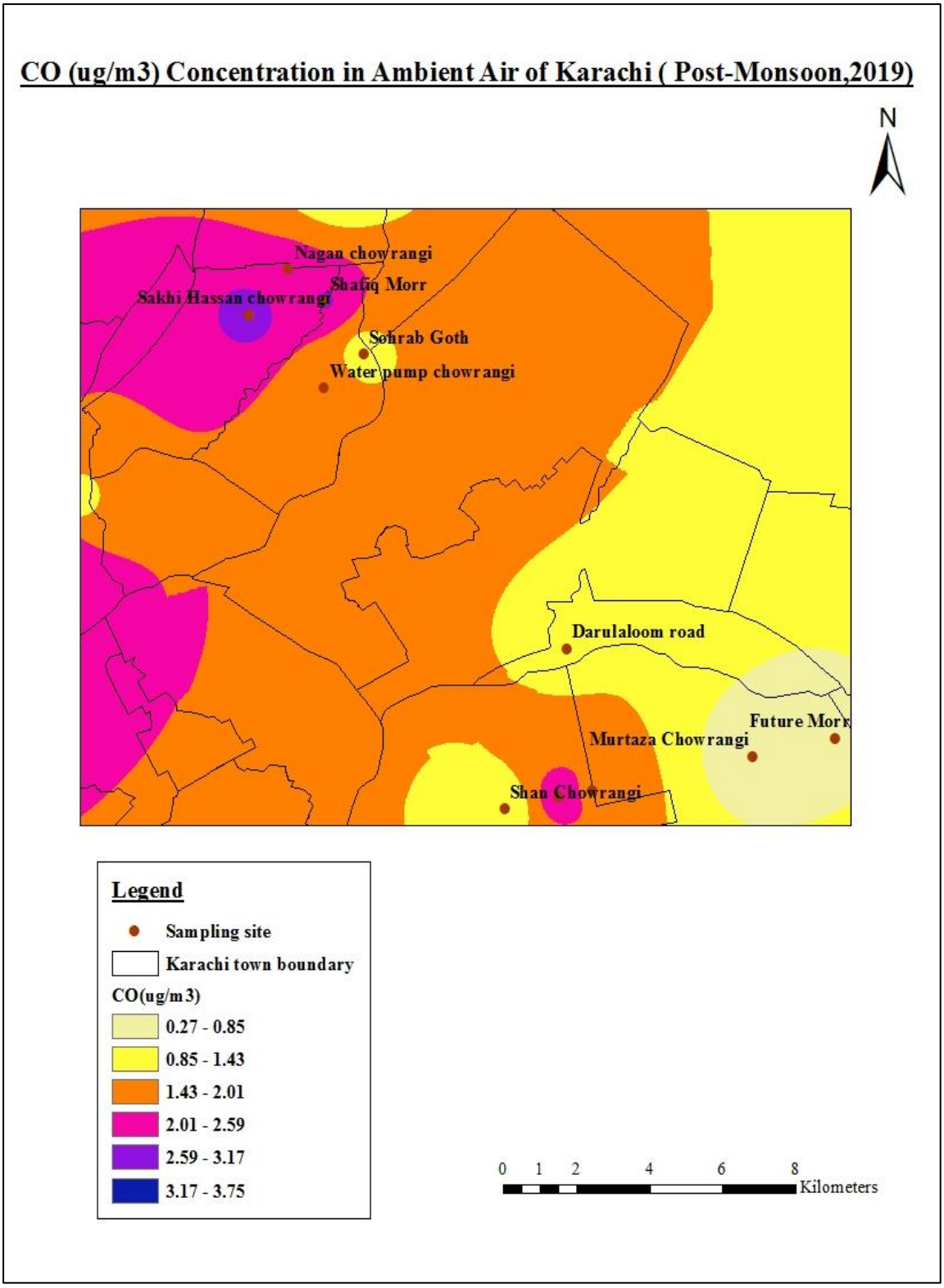

Figure 4.44 post moon soon CO in the industrial areas

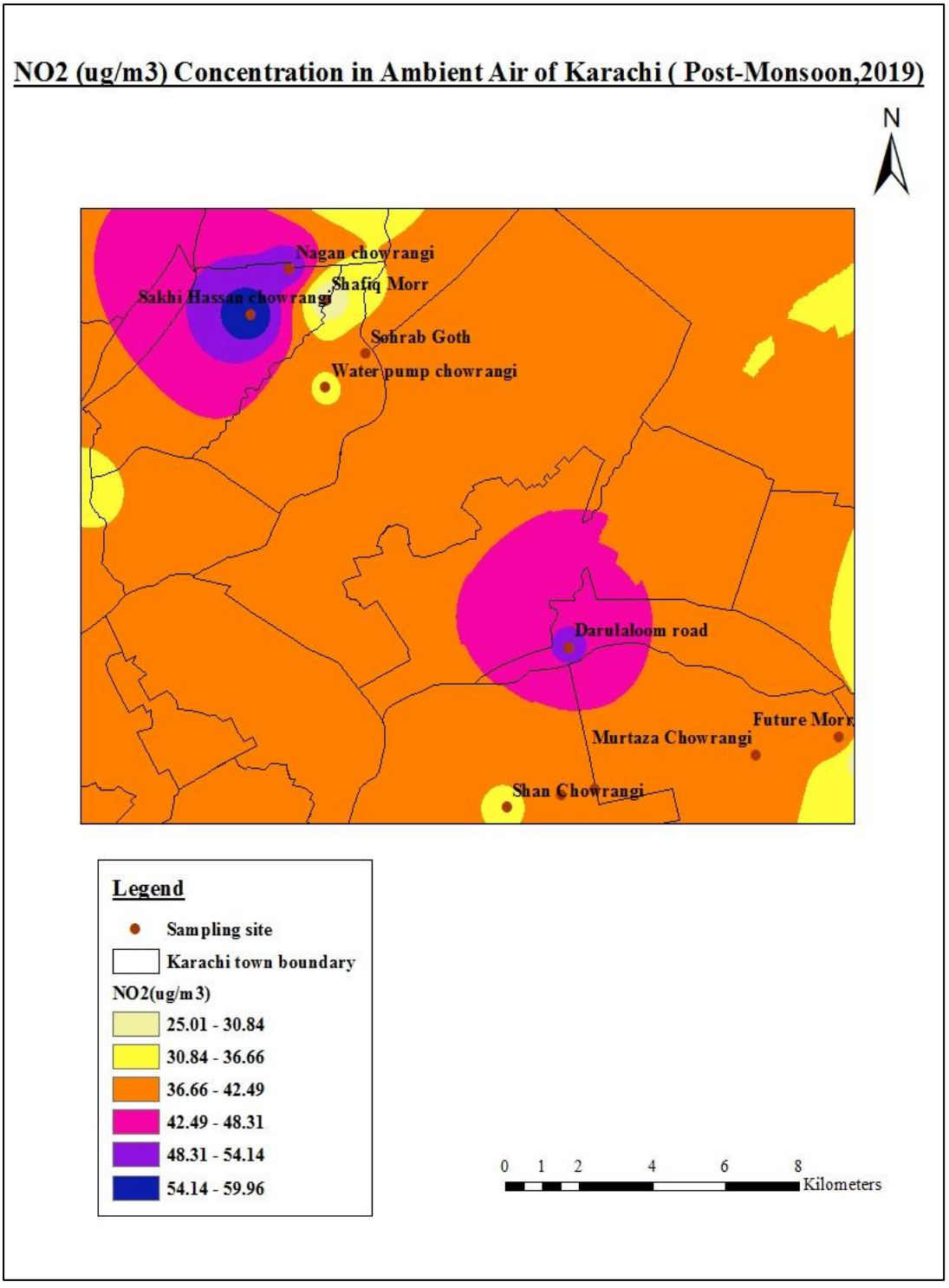

Figure 4.45 Post moon soon NO2 status in industrial areas

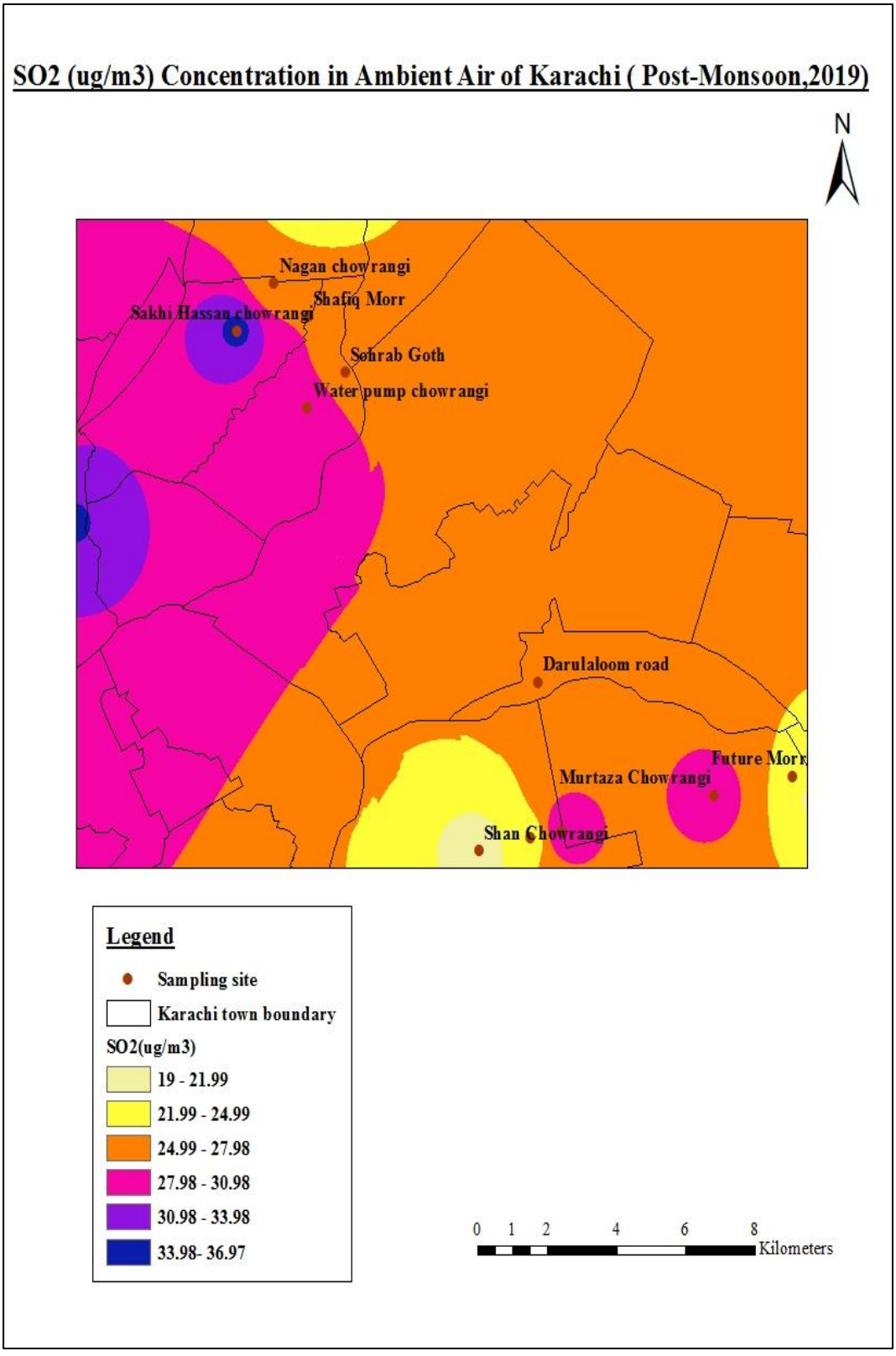

Figure 4.46 post moon soon SO status in industrial areas

Chapter 5

Results & Discussion

5.1 Vulnerability to Climate Risk Assessment

A Climate change risk assessment involves formal analysis of the consequences, likelihoods and responses to the impacts of climate change and the options for addressing these under societal constraints. Conventional approaches to risk assessment are challenged by the significant temporal and spatial dynamics of climate change; by the amplification of risks through societal preferences and values; and through the interaction of multiple risk factors. This paper introduces the theme issued by reviewing the current practice and frontiers of climate change risk assessment, with specific emphasis on the development of adaptation policy that aims to manage those risks. These frontiers include integrated assessments, dealing with climate risks across borders and scales, addressing systemic risks, and innovative co-production methods to prioritize solutions to climate challenges with decision-makers.(W. Neil Adger, 30 aptil 2018).

During this study accepts a method to characterize the susceptibility of the natural risks risk management in together the current day and underneath climate change circumstances.

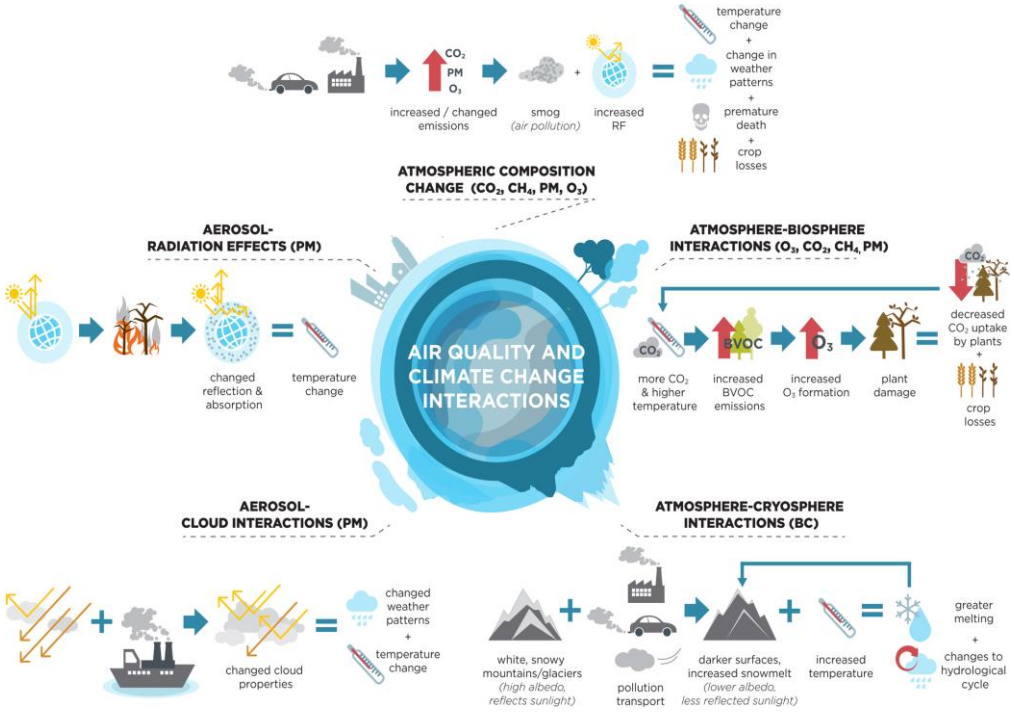

Figure 5.1 link between air quality and climate change("Chemistry and the Linkages between Air Quality and Climate Change," 2015; Von Schneidemesser et al., 2015)

Climate change and ambient air quality are perilous issues presentlt and in the coming future. Reports suggest that unless action taken air quality will be the largest cause of environmental cause of death("OECD Environmental Outlook to 2050: The Consequences of Inaction," 2012; Pomázi, 2012). Air quality in Asian countries is already far above the permissible limits for human consumption. Air quality and climate change are connected including emission, atmospheric properties. In most of the cases same source emit GHG and air pollutant e.g. release from vehicles include PM, NOx, CO and CO2. Further studies have shown that once in atmosphere PM influence by scattering and absorbing incoming radiation and sometime acts as cloud condensation nuclei.

Volatile organic compounds (VOC) in the presence of nitrogen oxides forms tropospheric ozone("OECD Environmental Outlook to 2050: The Consequences of Inaction," 2012). Similarly reaction of VOCs with OH radicals, O3 or NO3 produce proxy radicals; therefore replacing ozone in the reaction of NO to NO2 or nitrate radicals("OECD Environmental Outlook to 2050: The Consequences of Inaction," 2012). The chemical composition of ozone is essential to view the link between air quality and climate.

Given the diversity of approaches and the complexity of risk assessment, many public bodies with statutory obligations and private bodies with responsibility to shareholders have implemented formal risk assessments of climate change impacts. Across the spectrum of experience, they frame and prioritize climate change risks alongside other risks in order to implement timely responses. At the level of global public concern, the Intergovernmental Panel on Climate Change (IPCC) havedescribedtheadvantagesofarisk-basedapproachintermsofimprovedunderstanding of both the dynamic interactions of risk factors (spatial and temporal) that lead to specific climate change impacts, and the role of adaptation initiatives in managing these risk factors. Both the Special Report on Extreme Events and the Fifth Assessment Reports ought to characterize key global risks linked to current policy responses to provide recommendations for further inter-governmental action. Similarly, risk assessment has also been highlighted as a key procedure at national scale to facilitate target adaptations strategies and coordinated risk governance(W. Neil Adger, 30 aptil 2018)Following are the standard to be opted after characterization of risk assessment:

ISO 31000: 2009 Risk Management (Rm) – Codes and Guiding Principles

The international standard 3100-2019 RM provides framework, principles and a process for assessment the risk. The standard can be used by an organization of any size and number of employees, manufacturing product, any sector or activity. The risk management standard can help industries or organizations in the growth viewpoint of improve the identification of opportunities, achieving the certain objectives and

extortions and efficiently assign and uses of assets for hazard management. The standard also provides a direction on handling climate change hazards and comprises application strategies for appropriate and operational edition. Following are the deliberation of standard that:

The core objective of the climate hazard and susceptibility valuation is to decrease the consequence of climate change risk. The process adopted in ISO 31000 is included the following stages:

i. Considering understanding the nature of elements, which might be susceptible to current day and climate change risks.
ii. Creating criteria, which must be based on the study goals to support the assessment of the risk characterization significance and if dentify the hazards of climate?
iii. To recognizing climate change potential adaptation procedures and residual risk reassessment. Followings are the few adaptation measures in ISO3100 standard.

5.2 Initial Vulnerability Assessment (IVA)

The proper description of vulnerability to climate change is “the degree to which a system is susceptible to or unable to cope with, adverse effects of climate change including climate variability and extremes”. The IVA presents potential impacts’ initial screening and vulnerability to the recognized climate risks for the coastal areaas study area. The potential impacts posed by the ports and identified hazards which debate providing as to whether or not the harbour is probable or to be vulnerable to these threats. The IVA also provided the potential impact vulnerability i.e., carry out in more detailed assessment of risk in following section of 5.3.

Table 5.1. Coastal Area Initial Screening and Vulnerability Assessment (ISVB)

Hazard	Potential Impact	Description	Vulnerable
Present Day Hazards			
Temperature / heat wave	High temperatures for workforce	May slow down handling work and efficiency	Y
Extreme rainfall events	Flood	The coastal areas affected by flooding, although they may occasionally experience nuisance drainage issues.	Y
Drought	Water shortages	Significantly affects; no further assessment required.	N

Based on the IVA screening and vulnerability assessment, the below hazards will require more consideration and in depth assessment:

i. Heat waves/ high temperatures;
ii. Extreme/Heavy rainfall events;
iii. Elevated waves and sea water levels

5.2.1 Risk Assessment Framework (RAF)

The risk assessment is based on both seeing likelihood and consequences of occurring new event probability or frequency of RAF not likely uses such as likelihood or possibility uses as a common explanation for likelihood or occurrence, that is just how, likely it is that, somewhat or an event will happen. A resultant impact is product of an occasion.

5.2.2 A Qualitative Risk Assessment (QRA):

QRA is determining the hazard probability. For the climate risk and vulnerability assessment, probability of both historical occurrence and the level of assurance related with climate change projection for the main hazards.

Table 5.2. : Climate change projections

Likelihood	Description	Even Risks	Long term risks (under climate change scenario)
Almost Certain (L1)	Expected to occur in most circumstances.	Could occur several times per year.	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated.
Likely (L2)	Will probably occur in most circumstances.	May occur once every year.	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated.
Possible (L3)	May occur at some time.	May arise once in 5 years.	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated.
Unlikely (L4)	May occur at some time, but is considered unlikely.	May arise once in 5 to 50 years.	Has a 10–30% chance of occurring in the future if the risk is not mitigated.
Rare (L5)	Could occur in exceptional circumstances.	Unlikely during the next 50 years.	May occur in exceptional circumstances (i.e. less than 10% chance of occurring in the identified time period) if the risk is not mitigated.

Table 5.3. Risk Assessment Matrix (RAM)

Likelihoods	Consequences				
	C1	C2	C3	C4	C5
L1	Low	Moderate	High	Extreme	Extreme
L2	Low	Moderate	Moderate	High	Extreme
L3	Low	Low	Moderate	High	Extreme
L4	Low	Low	Moderate	Moderate	High
L5	Low	Low	Low	Moderate	Moderate

The possible significances of the threat are distinct as per the standards in Table 5.3. The significance measures reflect the possible for the achievement criteria to not be realized, and take into reason latent variations in the degree of the important climate threats.

Every risk occurrence was allocated an overall level of risk indomitable as a task of the likelihood of the result happening and the significance if the occasion happened.

Table 5-3 shows the consequences related with the C4 and C5 significances. The RMA are usually measured unsatisfactorily high due to their influence. A resulting evaluation of C4 and C5 or a greater than the C5 probability existence of a C3 significance, would also incline to leading the stages of risk graded high or extreme. Therefore, the risk graded high or extremes measured “unacceptable” for the determinations of Risk Assessment Finding (RAF).

Table 5.4. Risk Assessment Findings

Hazard	Risk Statement	Risk Category		
		L	C	R
Existing (Present Day) Risk				
Temperature / heat wave	High temperatures negatively impact on the health, water consumption and reducing work efficiency,	L2	C2	M
Extreme rainfall events	Heavy rainfall causes flooding of land and/or buildings, reducing efficiency and increasing handling times. The flooding may also result in damage infrastructure and can represent a risk to workplace safety.	L3	C2	L
Future (Climate Change) Risk				
Increased temperatures / incidence of heat waves	High temperatures negatively impact on the health, increase water consumption, electricity and reducing work efficiency,	L1	C3	H
Increased intensity & frequency of extreme rainfall events	Heavy rainfall causes flooding of land and/or buildings, reducing efficiency and increasing handling times. The flooding may also result in damage infrastructure and can represent a risk to workplace safety.	L2	C2	M

5.2.3 Adopted Climate Change Adaptation Review Measures

The various measures can be adopted for climate change. Each measure has its own charges and benefits that would be measured:

i. Low-regret approach: An approach of climate-ready; the implementation of measures in future might whichever be technically infeasible or prohibitively costly.
ii. No-regret approach: An approach of attainment of economic benefits; the implementation of measures will only carry economic remunerations regardless of the degree of climate change.
iii. Approach: The approach is implementation of measures in such a wau that the adaptation measure has latent to convey other socio- economic remunerations in adding to decreasing climate risk.

Table 5-6 also shows the series of adaptation measures laterally with conversation of the pros and cons of every measure. Moreover, the measure A, B, C and F are effectively addressing the same hazard, and it would not be necessary to adopt all three measures.

Table 5.5. Potential Adaptation Measures

Measure	Notes
Heat waves	
Option A: Develop a policy that includes measures to reduce the health risk	Low cost, no-regret option ▪ Reduces risk of heat stroke ▪ Behavioural adaptation required ▪ Will require provision of suitable personal protective equipment (hats, long sleeve shirts, sunscreen, etc.), drinking water and access to shady or air conditioned areas ▪ Recommend implementation from day one.
Flood / Storm Surge	
Option B: Develop a policy and plan that includes measures to reduce the risk	High cost or no regret option ▪ Spatial flood plans ▪ Flood defence and drainage systems ▪ Flood safety ▪ People and assets safety plan ▪ Resources flood control plane ▪ Drainage basins safety ▪ Belongings areas of flood map ▪ Emergency response systems (Include emergency medication, healthcare, hearth provider) ▪ Vanishing green defence areas ▪ Suitable Preventive Steps for climatic threat
Temperature	
Option C: Develop a temperature reduce policy and plan that includes measures to reduce the risk	▪ High cost or no regret option. ▪ Human settlement and Infrastructure ▪ Transport ▪ Industrialization ▪ Fossil gasoline consumption and CO_2 emissions ▪ Water resources and usage
Drought	
Option D: Adopt water resources develop and conservation policy and plan that includes measures to reduce the risk	▪ High Likely to be a low or no regret option. ▪ Estimation and development of fluctuations in uses and additionally identifying the extra water confused areas. ▪ Water conservation practices ▪ Water delivery mission and distribution plan ▪ Special plan for high temperature and heat wave ▪ Sources for Emergency health care

All options would necessarily be adopted: Similarly, not all options may be opted due to some other reason, such are:

i. Cost: The implementation cost of such measure if too high relative future benefit accrued;
ii. Negatively impacts: If the option causes the negative impacts on operations, whether in the present day or in the future.
iii. Infeasible: If the measure is infeasible, the option may otherwise not possible for the cost-effective source larger armour units.

Existing and Future Climate Risks:

The standard is dedicated to assist the developing countries in climate control measure and to confirm their consequences would not be compromised by natural hazards in general and climate change variability in specific. The commitment also requires consideration of the impact of natural hazards, and in particular climate change, on its infrastructure investments.

This study is providing the future risk as well as the current risk in accordance with the climate risk management framework (CRMF) requirements. The risk assessment is not climate irrepressible, mainly with reverence to the wave climate. The key climate related hazards identified in chapter 4 discussed as:

a. Heat waves
b. Increased temperatures
c. Drought
d. Floods
e. Clime threat

5.3 Risk Assessment and Preventive Measures of Temperature

The perils presented by means of ocean degree upsurge itself for the metropolitan Karachi could be unimportant in the little period yet it might arise as a justification for trouble in a lengthy course. All things considered, since the science and related examinations are deficient about the environmental change in the area, but the level headed about possibilities and apportioning with expectations instead of certainties and conjectures. The greatest practical and coast strong strategy to diminishing the ocean level rising impacts inside the extended term is the blending of measures into structure format and creating arranging inside the brief time frame period. Such a method could decipher the drawn out risks of maritime degree into an incredible system and the board inconvenience for these days.

The exhilarating climatic occasions along twister suggestions related with the metropolis ought to have an additional desperation due to cut off repeated heat event throughout the late spring season. The significant flooding and glimmer flooding related with a super cyclonic occasion can achieve genuine harm to organizations and home edifices, interruption of financial action (for example On the Karachi Port and Fish Harbour) mishaps and fatalities, ecological harm in view of wetlands obliteration, immersion of seven sewage and damage of low lying private/relaxation locales and beach front fishing gatherings. Immersion of water everything through tempests can disturb supply of consumable water and sully water components with saltwater, compound substances and waterborne three ailments.

The Indus delta floor subsidence has previously come about because of seawater interruption and upstream of the delta stretching out however much 80km inside the shoreline zones of Thata, Badin and Kotri districts (Panhwar, 1999). The rule angle estimated i.e., downstream Kotri flood deficient water stream into delta is liable for attack of sea water enthused about the Indus delta area. Notwithstanding, conceivable measure and impacts of salt-water interference close by the Karachi shoreline are but at this point not extremely clear in term of financial misfortunes(Pakistan, 2016).

Loss of lives and actual resource: The reasonable planning and specified satellite information would be expected to recognize the specified ground conditions for the lives and framework being harmed because of ocean interruption since the last ten years of twentieth century and proceed. The projection of on-going information be available for the order of effects and misfortunes while working on the waterfront areas and human settlements.

People Settlements: as far as neighbourhood clans bunches situated in the spot opportunity region, the greatest measured humanoid settlements each in relations of their exposure and defencelessness are fishing gatherings, which they abiding in fishing settlements dispersed close by the Karachi shore. No predetermined zone inspected has been executed on the fisheries zone in view that the 1986 and there has been no canvases at the evaluation of fish shares wanting the 12-200 mile region for quite some time. In sync with the Government, monetary organization of Pakistan (2005), in GDP the stake of fisheries is extremely low as 0.3% even the offer in horticulture area isn't over 1.3%.

Fisheries: despite the fact that fisheries industry is done being a worth supporter of the countrywide abundance in term of gross public item, regardless backings significant financial vocations and both the financially incredibly slanted gathering of industry. Fishery is a commodity fixated segment of nation and the Karachi component and the Karachi Fish Harbour assume an essential part in keeping up with its elements. For trades, the essential fishery is for prawns and the greater part of the snare is arrived in Karachi fish harbour where the fish is handled through the approved exporters to European Union (EU) and rest of the world nations with the power of Marine Fishery situated in Karachi a subsidiary of Ministry of Maritime undertaking Government of Pakistan.

Moreover, it is normal that 10,000 labour force (10,000 families) along with more prominent than 30,000 (Family heads) working in the Karachi Fish port residing in the area i.e., Ibrahim Hyderi (most extreme populous shore fishing town) and different score offices in Korangi Creek and some spot else near Karachi rely on fisheries. Baba Bhit island is minimal local area of Keamari region which having approximated land region is 4Km2 than the home-grown shore social orders will be the number of inhabitants in the double islands of Babaand Bhit.

Foundation: people in general and individual framework overwhelms monstrous segments of metropolitan coastline. The foundation fluctuates in nature, similar to energy creation plant, harbours and ports, municipal sewage treatment plants.

Public properties and framework: There are some extremely essential foundation of public importance are found right close by the bank of metropolitan. They include power and energy plant (KANUPP), the Karachi harbour (port and fisheries), key infrastructure (KPT, Himalaya) and Port Qasim (PQ). The foundation inclined to climatic effects, which it get in term of worldwide, warming, changing in sea compound piece and so forth

Mauripur wastewater treatment plant (assigned as TP-3 is having 54 million gallon per day limit, for the most part stay non-functional and under upkeep) is comparatively situated neighbouring the Lyari River bank. The taking care of framework work in the coastline district is at incredible risk because of twisters, suffocating and the connected disintegration of salt-water entrance. In adding to these taking care of capacities themselves, the materials for drainpipes might be gotten through erosion and a developing water work area. The aggregate channel outfall structures, including for the span of inordinate precipitation occasions in metropolitan, can be in adding yielded through discharge or greatness discharge inconveniences as ocean level accelerations during the rainstorm and full moon days.

Table 5.6. Sewerage Treatment Plants in Karachi

Sewerage Treatment Plants	Optimum Design Capacity	Actual Treatment
STP-I – SITE	51 MGD	20 MGD
STP-II – Mehmoodabad	46.50 MGD	00 MGD
STP-III – Mauripur	54 MGD	35 MGD
Total	151.50 MGD	55 MGD

Sources: (Tahir, 2017)

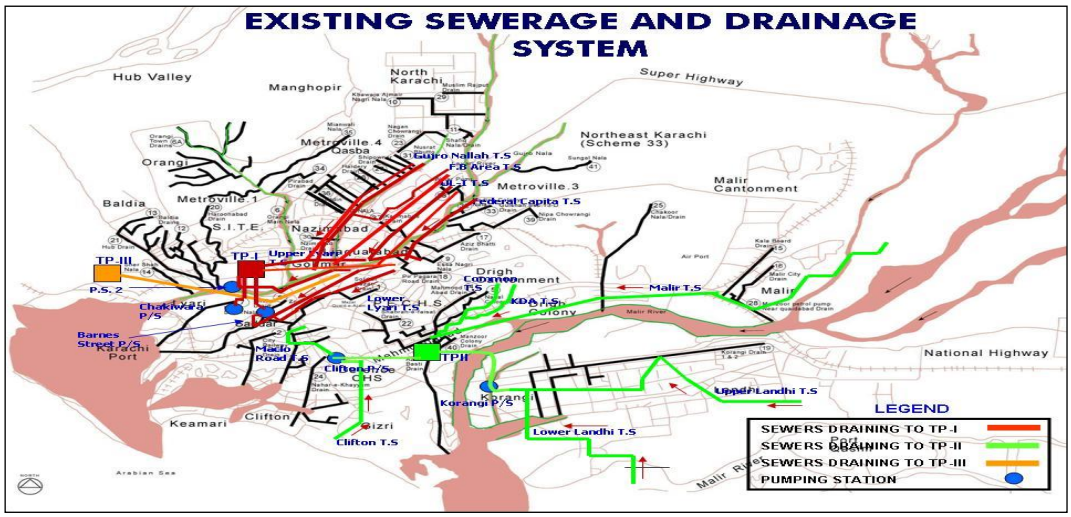

Figure 5.2 Map of sewerage treatement plant Karachi(Scheurell et al., 2009)

Private /Personal infrastructure: Private facilities and unauthorized infrastructure is a vital challenge for the metropolitan planners and decession maker. This infrastructure included the residential colonies, enterprise and undertaking areas being constructed waterfront terrestrial sideways the Clifton seashore, and for illustration coastline, reclamation terrestrial has additionally occupied into account for development of anthopogeinc intervention which casuses the possible effects on the coastal hydrology, destruction and settelment designs.

Metropolitan coastal expansion Plan 1990-2000:

Serves as the rule of thumb for coastline old-time improvement as in line with the Karachi structure and urban making plans guidelines, in which the whole 40 mile Band of Karachi coastline encompasses accurate from Hub River, creek transient over Hawks bay, paradise point, Western Eastern backwater, Gizri, Manora island, Clifton belt, Korangi Creek and Defence, and up to Gharo creek area is an old regulator place for the tenacity and sightseeing.

5.4 Risk Assessment and Preventive Measures for Drought

The dry spell influencing Karachi would depend on an extent rainfalls, with draw out time of consolidated precipitation, and how infiltrating the convey call for strength for the assorted arrangement locales is to dry season. Destructive, principally developed on such an examination the water arrangement backer should disperse its source area into lesser water support districts, which are distinct on the foundation of water convey association. Such estimation for us doesn't occur. In any case, a genuine cognizance should be that a dry spell circumstance will never again convey calamity; it could deteriorate a formerly current catastrophe. There is a fundamental for the KW&SB to course on a figure of heads. There is a squeezing need to diminish the absence of water through spill control that can happened contained by the system of a more prominent innovativeness to absorb the disintegrating structure and keep away from theft.

Water execution may progressed over introducing water metering that could bring about fitting appraisal of interest and improvement of related pattern in varieties in utilizations and moreover perceiving the additional water befuddled regions. There might be a fundamental to energize water saving practices together on the transporter organization and the supporter degree. There might be huge water adequacy limit in the utilization of recovered water for non-drinking uses.

The spotlight as of now is coordinated absolutely on increasing water convey (e.g cognizance on k-IV mission to bating 100 MGD more noteworthy water for Karachi, for the Indus stream source), despite the fact that a choice in itself. It can handiest give most solid favours if various components extraordinarily at the conveyance level which can be impeding proficiency in water convey and usage are handled on a critical establishment all the while, if not with a more priority. Be that as it may, for this to occur, the water programming wants to be monetarily feasible at first. A political will for all encompassing institutional changes upheld through material strategy and authoritative mediations are the handiest way to talk this undertaking.

Inside the circumstance of the rustic agro-metropolitan quarter in Karachi, there is a basic need to Study and finish off the ground water resources through appropriate procedure and challenge made absolutely mediations likewise to seeing at empowering adept utilization of the water resources. This could happen inside a more prominent setting of defensive the vulnerable earthly utilization of the rustic region and developing a novel innovative and insightful of this landmass and related monetary framework as an attainable and viable inventory of offering suppers' insurance for Karachi and moreover showing up as a fence to the accidental, liberated and unmaintainable metropolitan expansion. Extreme warmness procedures warmness waves are typically depicted as drawn out terms of hotter than normal temperature regardless of the way that the appropriate planning and tama critic than normal inside the circumstance of exorbitant hotness levels. The ensuing mindfulness zones are fact estimated.

There is a deficiency of particularity inside the portrayal of an over the top warmness event or warmth propensity because of the meaning of adjacent transformation to climate, which vacillates geological going before study demonstrates that general population in unique destinations have changing capacities to address temperature abundances. As an example, stages of preparation in phoenix (US) have found no genuinely enormous relationship among fleetingness costs and extreme temperatures under 43oC, while in Boson (US), and development in the charges of humankind is situated at 32 C^{o}.

There might be various explanations for those adaptable answers; in the event that exceptionally high temperatures emerge at intriguing spans, the residents probably won't have the proper level of planning to manage astounding dissimilarities. Lodging frameworks have a section to show as in areas in which bloodless weather conditions is extra of a standard, most extreme houses built from warmth-keeping materials and hardly any houses have head air conditioner . Accordingly, for the term of extreme warmness events, surrounding air temperature indoor such main residences may be riskily unreasonable. As an impact of environment exchange, dangerous hotness events expected to change over more normal, unreasonable and lengthier long haul over most extreme land areas, inside the

circumstance of Pakistan regularly and in Karachi chiefly, temperature degrees are relied upon to up push.

In Karachi, ordinarily mid-year are warm and drawn out and temperatures in excess of 30 ^{o}C care somewhat the standard. Sooner or later of the investigate, no such insights can be found that might recommend expiries because of steady more than normal warmth waves say in excess of 40 ^{o}C.

Settlements as a result of their extraordinary earthbound use and improvement blueprints can make selective nearby circumstances while relating with warmness events called the city warmth Island sway. The metropolitan warmness island characterizes the warm temperature of the exterior and climate that city area liquefy revel in evaluation to the rustic zones that encompass them. As related to country zones, towns tend to have modern surface and air temperatures because of the metropolitan hotness island impact.

For the normal laid out country city of 1,000,000 individuals, this display can reason temperatures, which may be 1C to 3C better than the town' encompassing area. At evening time while city warmth-island assets are stoutest, temperature changes can achieve 12 C. With the guide of expanding temperatures, city warmth-island results can deteriorate the hotness related unfriendly surmising's of environmental change and execute profoundly evaluated energy strains on metropolitan plans as they endeavour to acclimate to higher temperatures, extreme hotness exercises destructively impact upon humanoid wellness and cultural steadiness, blast power order affect water convey. Warmness waves are further to impact upon defenceless peoples, which incorporates the matured, exceptionally more youthful, substances with pre-present wellness circumstances and the metropolitan poor. The city poor in created areas are especially at an extended risk from over the top hotness events as of their little versatile potential.

The components of those results are be that as it may, presently not constant cross-towns. The substantial blueprint of a metropolitan, its general population degree and focus, and authoritative constructions of the raised climate all influence the profundity of the city warmth island sway. In a couple of towns, the glow made by guests drive, cooling structures, business discharges and different power uses figures

on the hotness reality produced since the streets and constructions, additional increasing temperatures, this will be called as an anthropogenic (synthetic) contribution to the city heat island impact.

5.5 Risk Assessment and Preventive Measures of Flood

Yet again Karachi needs to perspective metropolitan flooding events inside the past and it can happen. It is by the by difficult to instructional course a chance and connected strength with any characteristic of exactness in view of outrageous holes in records and related investigations each in relations of anticipated precipitation ranges and the understanding of additional precipitation into a metropolitan flooding event. The limit people and social orders probably to be inside the flood peril region likewise are reasonable the layout of being shockingly inclined. The assets in danger decide significantly not best at a nearby anyway countrywide stage in relations of their inclusion to the public monetary framework and blast. Inconveniences related with the way we are taking care of (blundering!) the city land and establishment correspondingly confound and intensify a generally present possibility(Merz et al., 2014).

The point of convergence has been to takings shrivel a chimney battling demeanour with every one of the connected deficiencies in response instruments in to take brief term temporary processes with no supportability required to them. Climate variety release is all roughly being coordinated. From diminishing, the opportunity of mischief to being totally ready to fulfil the suitable results is anything that adjective potential is all around. For that to appear, an example assignment in making arrangements meanings is compulsory. The need is to move quickly on more than one heads to manage this inconvenience which can comprise of a reinforced awareness on study and examination and execution of pertinent inclusion structures for helping imperative making arrangements and task fundamentally settled obstructions.

The chance of the investigate couldn't allow explicit awareness into various go-decreasing topics along with conceivable impact and impacts for the native monetary framework, local area and more prominent check administration parts, etc.

However, they are additionally of fundamental importance as an environment substitute circumstance has what may be known as a flooding sway with one zone of the city act associating with the choice to make a troublesome school of pretty much nothing and stretched out length harms and deterrents to the increment way of the metropolitan(Merz et al., 2014).

5.6 Risk Assessment and Preventive Measures of Climate Threat

The discoveries of this examination exhibit the expected significance of modern action, assembling and toxins discharges to the huge fixation in surrounding air. As there is serious modern movement of all sort is available in Karachi, the surrounding quality of Karachi is a house for holding harmful components and gases, antagonistically affecting the climate and its inhabitants of Karachi. Concentrate on information shows that three significant zones S.I.T.E, Korangi and Landhi modern region at high openness of gases and other harmful component. While North Karachi due to small scale industry is comparatively at less risk. There could be no appropriate execution of regulations given by the dependable specialists like SEPA and EPA by.

The review is one of the first to explore the connection between particulate air contaminations in city Karachi where particulate levels are very high. The PM 2.5 levels averaging around 5 - 7 overlap higher than the WHO rule. Particulates estimated at two locales, one more modern than the different was, however as a rule, the examples over the long run were comparative. Studies, as has been exhibited somewhere else in created nations, that more significant levels of PM 2.5 are related with a striking height in paces of hospitalizations for cardiovascular sicknesses (ischemic coronary illness, hypertension, myocardial localized necrosis). Due to the striking degrees of air contamination that is archived, basic further examination of wellbeing results in super city of Karachi be performed.

From the review investigation, it is presumed that S.I.T.E, Korangi and Landhi modern regions are more defenceless against the openness of the harmful surrounding air contaminations. For the most part PM10& PM2.5 and NO2 in light of the fact that there are an excessive amount of various huge and little ventures are available and useful. Generally modern region alongside heavy traffic zones and not consistence with SEPA guidelines, in this manner expanding the dangers of wellbeing sway. Also, the incessant illnesses, as indicated by the Physicians examination, were Airway and lung disturbance, Bronchitis, Eye Irritations, Sleeplessness and Headaches (ARSALAN, 2002). The proposed environment hazard will change the environment conditions in future and is normal that it will increment in future. Coming up next are the key vulnerability recognized:

- Flooding that might harm to framework
- Trouble for getting to antagonistic weather patterns
- Unfriendly atmospheric conditions might prompt climatic dangers
- Need to guarantee give safe climate.

Environment Resilient Measures (CRMs): The coming up next is the particular estimates cosiest with the prerequisites of the ABCD created to environment dangers. This action was related to potential environment related chances and to address the arranged and exact systems to diminish helplessness and recuperate the adaptability:

Strategy: choosing suitable rules for strategy for existing and future environment dangers;

Counteraction Measures: To select avoidance measure for catchment of land because of flooding, such anticipation might be giving a coastline revetment, land loading up with appropriate floor levels or structures; and

Structure embracing and guarantee that the constructions are fit to endure the flood wave constrained conditions.

It is likewise important to quantify the expense of environment tough execution. The incremental temperatures are likewise distinguished as a gamble to the potential effect populace of Karachi. Henceforth, an approach improvement at public level ought to be selected quickly to deal with the gamble of incremental temperatures in metropolitan starting around 2014. These are the actions to be consolidated in approach and consider dealing with the gamble, for example,

- Working hours: Labour working hour ought to be adaptable, for example, stopping working in shifts all through exceptionally high temperatures;

- PPEs: Personal defensive gear, for example, long-sleeved shirts, caps, shades and sunscreen ought to be ensuring during working;

- Shed Area: Provision of shed region or cooled zones for labourers look for span from the hotness if essential; and

- Water: arrangement of enough volume of water and caffeinated drinks during working hours.

Amazing open doors for Improved Resilience and Sustainability: The opportunity to work on the supportability and flexibility, there are different others plan choices available to pick with an assessment to refining the normal malleability and manageability(ARSALAN, 2002). The dependent factors on spending plan and existing ability such are:

Waste methodology - Flush flooding because of high precipitation isn't positioned as "high" risk, however because of the environmental change conjectures showed the possibility of enormous accelerations in precipitation strength and it very well may be esteem additionally to thinking about the seepage system. It is likewise reasonable to be assessment the dimensions of waste to affirm that the plan oblige the approaching precipitation conditions; and

Manageability - To benefit the open doors through the arrangement arranging cycle to consider esteem increments like fused the protection of water consumption and temperatures too.

Suspicions and Limitations:

- The evaluation depended on the primer review.
- The evaluation has made a displaying based and assumed a 25 years for the assets.
- The relevant rules and norms would be utilitarian in the methodology and working of the design.
- The gamble study is primarily subjective evaluation in nature and is organized in view of the accessible data at season of planning.
- The natural and social impacts (for example earthly inhabitancy impacts) of the recommended variation choices have not been pondered as part of this valuation.

Chapter 6

RESULTS & DISCUSSION

6.1 Overview

In this chapter, discussion is to divide into five different sections. These sections designated as:

a) Result and Discussion on 20 Years back Previous Obtained data;

b) Result and Discussion on Self-Monitoring or sampling data based on pervious data. It included as

- Temperature
- Drought
- Heat waves
- Floods.

c) Result and Discussion on 05 Years Predicted data that based on 20 Years pervious data and self-monitoring data;

d) Result and Discussion on 03 Years Ambient Air Quality Monitoring Data (Pre-monsoon and Post monsoon). It included as:

- Carbon Monoxide (CO),
- Nitrogen Oxides (NOx),
- Sulfur Dioxide (SO_2) and
- Total Particulate Matters (TSPM, PM_{10} and $PM_{2.5}$).

e) Overall Review on Results and Discussion on findings.

6.2 Result and Discussion on 20 Years Back Previous Obtained Data

About 20 years back data gained from Karachi Air Port. Data shows mean values of temperature (°C) / whole day temperature mean on monthly basis as given (1996-2016) as shown in Table 6.1.

Table 6.1. Mean Monthly Temperature -°C (1996-2016)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1996	18	21.1	25.9	28.8	30.9	32.3	30.7	28.3	28.7	28.4	23.5	19.7	26.4
1997	18.4	21.3	24.6	25.4	29.9	31.2	31.4	30.3	29.8	27.9	24.7	19.7	26.2
1998	19.4	20.8	25.8	29.9	32	32.4	30.7	29.6	31	29.3	25.2	21.9	27.3
1999	11.9	22.3	26.6	30	31.2	31.4	30.1	29.4	29.7	30.3	26.2	21.4	26.7
2000	19.5	21.4	25.6	30	30.9	31.7	30.4	29.2	29.5	29.6	25.7	21.5	27.1
2001	19.4	22.3	26.4	29.2	31.6	32.3	29.6	29.4	29.5	36	26	23.1	27.9
2002	19.9	21	26.4	29.6	31.3	31.6	29.5	28.3	28	29.4	25.1	21.4	26.8
2003	20.1	22.7	26.1	30.3	30.6	31.4	30.9	29.7	28.9	28.9	23.7	20.1	26.9
2004	19.7	22.2	27.7	30.2	32	32.1	30.6	29.5	29	28.1	24.3	22.4	27.3
2005	18.6	20.8	25.9	29.1	30.9	32.3	30.3	29.4	30.4	29	26	20.7	27.0
2006	18.9	24.7	25.7	29.4	31	32	31.1	28.7	30.5	30.4	26.4	20.1	27.4
2007	19.9	23.4	25.5	30.3	31.8	32.5	31.3	30.1	30.6	28.6	26.2	20	27.5
2008	17.2	19	27	29.2	30.6	32.1	30.7	29.4	30.7	29.6	25	21	26.8
2009	20.5	23.1	26.9	29.9	32.2	32.2	31.3	30.3	29.6	29.3	25	21.3	27.6
2010	19.9	22	27.7	30.5	32.3	31.5	31.5	30.2	30.2	29.9	25.1	19.6	27.5
2011	18.9	21.5	26.5	29	31.2	32	31.1	30	29.6	27.7	26.7	20.8	27.1
2012	18.5	19.4	25.4	29.8	31.3	31.3	30.6	29.8	29.8	28.8	25.6	21.2	26.8
2013	19.1	21.5	26	29.1	31.1	32.9	30.9	29.4	29.2	30.6	25.2	20.6	27.1
2014	17.3	20.5	25.3	29.7	31.5	32.8	31.1	30.3	30.3	29.8	26.2	20.9	27.1
2015	19.5	22.7	25.3	30.8	31.9	33.8	31.2	29.6	30.5	30.3	25.8	20.6	27.7

In last column, mean values of temperature of each year as given. Mean of Monthly Temperature values obtained from source of Karachi Air Port (1996-2016). Collectively difference of Mean is 1.5°Cin last 20 years. Similarly, data as given in table 6.2.

Table 6.2. Mean Monthly Temperature-°C (2017-2019)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2017	19.2	22.1	26.3	29.3	31.3	31.9	31.4	30.4	30.0	29.9	25.4	21.8	27.41
2018	19.4	21.7	26.6	29.6	31.2	31.8	31.6	30.5	29.8	30.0	25.8	21.6	27.46
2019	19.7	22.0	27.0	29.9	31.5	32.3	32.0	30.9	30.2	30.3	26.0	22.0	27.81
Difference = Mini. Mean –Max. mean													0.4°C

Mean Monthly Temperature-°C (2017-2019) are determined through this research study. This data is on three years based data. Also showing mean values of temperature in its last column. As data was analysed for difference of mean to find value of increasing temperature and value is 0.4°C for these three years (2017-2019).

Data clearly shows impacts of temperature is increasing by yearly as 1.5°C in 20 years and 0.4°C in three years. On base of these means values, can be calculated impacts that may be increased or decreased temperature values in further 06 years. However, data is showing impacts of temperature gradually increase then further next 06 years means values will increased. Moreover, these gradually increasing values in temperature make reason of Global warming and climate change.

6.3 Result and Discussion on Self-Monitoring or Sampling Data Based on Pervious Data

Similarly, data as given in table, Mean Monthly Temperature-°C (2020-2025) are predictable data on base of last 20 years data for this research study. Also showing mean values of temperature in its last column. As same as for difference of mean to

find value of increasing temperature and value is 0.87°C for these six years (2020-2025) as shown in table 6.3. As above mentioned its impacts observed on following factors as:

Table 6.3. Mean Monthly Temperature-°C (2020-2025)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2020	19.7	22.0	26.4	29.8	31.3	31.9	30.5	29.4	29.6	30.1	25.3	21.2	27.95
2021	19.6	22.0	26.5	29.7	31.4	32.0	30.5	29.4	29.7	30.1	25.3	21.1	27.27
2022	19.5	21.9	26.4	29.8	31.3	32.0	30.8	29.5	29.1	28.8	25.2	20.7	27.08
2023	19.2	22.1	26.4	29.8	31.3	32.1	31.0	29.7	29.8	28.9	25.3	20.6	27.18
2024	19.0	21.9	26.4	29.7	31.5	32.2	31.0	29.7	29.9	29.1	25.6	20.8	27.23
2025	18.9	21.8	26.1	29.6	31.4	32.2	31.0	29.7	29.9	29.4	25.8	20.5	27.19
Difference = Mini. Mean –Max. Mean													0.87°C

6.3.1 Temperature

There is clearly show the impacts of temperature is growing year wise as 1.5°C in 20 years back and 0.4°C in three years. In the light of these numbers, can be estimated and concluded impacts that may be high or low temperature values in future six years. On the other hand, data is also presenting influences of temperature, which increasingly. It will be increased in further next 06 years means values. Moreover, these gradually increasing values in temperature of Global warming and climate change.

6.3.2 Drought

Drought caused due to less rainfall during a season or year, which might be less than expected per year. Droughts might either be quick and protracted. Sensible managing of water assets, in phrases of assembly the source and call for hole can substantially decrease the viable detrimental influences of a drought upon us and at the surroundings.

As study area, Karachi already faces a disproportionate population increase due to immigration and many other reasons, the pressure on resources leading to depletion. Moreover, the rainfall events are shrinking and the influences of a probable drought duration might be intense. However, the potential of the supplier company to satisfy the viable concerns can be a better purpose of difficulty.

As 3D graphical data obtained from PMD showing, annually impacts of drought in Karachi City. As same as 20 years back data obtained which is showing great increasing impacts of drought due to less rainfall. In addition, on the base of these impacts, data has been further revalue with the addition of average mean of 20 years back data. As a result, predicted data is derived and added. This data further based on 05 years as can be shown in each 3D figure according to month wise.

It is observed that drought`s impacts increase respectively on each month. It is a major factor of climate change. Due to less rainfall drought increases. It is inversely proportional to rainfall. In addition, rainfall frequency is directly affected by climate change.

6.3.3 Heat waves

As a study area, Karachi has been under attention to elaborate impacts of climate change. Karachi has an arid climate, although a moderate version of this climate. Karachi is located on the coast and as a result has a relatively mild climate. Karachi has two main seasons; summer and winter, while spring and autumn are very short. Summer season persists for longest period during the year. Karachi also receives the rains from July to September. The city enjoys a tropical climate encompassing warm winters and hot summers. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is northeasterly.

Climate commonly defined as the weather averaged over a long period. The standard averaging period is 30 years; other periods may be depending on the purpose. Climate also includes statistics other than the average, such as the magnitudes of day-to-day or year-to-year variations.

The mentioned Heat waves (Maximum Temperature of the day/peak of Temperature) data and graphs of 30 year (1996- 2025) of Karachi shown in Table- 6.4 and figures 4.27 to 4.39.

Table 6.4. Mean Monthly Maximum Temperature/peak of Temperature (°C) (1996-2025)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1996	27	29.3	32.5	34.9	35.4	35.9	33.8	31.1	32.2	35	30.8	27.9	32
1997	25.5	28.6	30.6	32.1	34.4	34.5	34.1	33.2	33	32.3	30.7	26.1	31.3
1998	26.1	27.5	32.3	35.4	36.6	36	33.4	32.5	35.3	35.6	33	29.2	32.7
1999	26.2	28.7	34.8	36.2	35.2	34.5	28	32.4	32.8	36.7	33.2	29.1	32.3
2000	26.4	28.1	32.6	35.4	34	34.8	33.2	32.2	32.9	35.9	32.5	29.2	32.3
2001	27.2	29.6	33.1	34.6	35.1	34.8	32.1	32.3	33.1	36	33.5	30.4	32.6
2002	27	28.2	33.3	35.4	35.6	35.1	32.2	31	31.3	36.5	32.7	28.1	32.2
2003	27.6	28.5	32.3	36.6	35.7	34.8	34.1	33.5	32.5	37	32.2	28.3	32.8
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.5	32.6	32.8	33.7	30.7	29.4	32.8
2005	24.9	26.2	31.4	35.2	35.4	36.1	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26	31.3	31.8	34.3	34.6	35.4	33.9	31	34.2	35	33.4	26.3	32.3
2007	26.8	29.4	31.3	36	36	36.3	34.7	32.8	34.5	35.9	33.9	27.1	32.9
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32
2009	26.2	29.8	33	36	36.8	35.7	34.5	33	32.8	35.9	33	28.6	32.9
2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33
2011	26.9	28.5	33.3	34.8	35.3	35.2	34.3	33.1	32.7	33.2	33.1	28.8	32.4
2012	25.7	26.9	31.7	35.1	35.5	34.6	33.2	32.7	33.2	35	32.7	28.2	32
2013	26.7	28	33.3	34	35.1	36.5	33.8	32.1	33	35.7	32.3	28.3	32.4
2014	25.5	28	31.7	35.1	35.9	36.5	34	33.7	33.8	36.3	32.9	28.7	32.7
2015	26.3	28.9	31.5	35.9	36	37.7	34.1	32.3	34.6	35.8	33	28.6	32.9
2016	26.2	28.8	32.9	34.9	35.2	34.9	32.5	32.1	32.9	35.2	32.1	28.3	32.2
2017	26.4	28.6	32.9	35.0	35.2	34.8	32.5	32.4	33.2	35.3	32.5	28.4	32.3
2018	26.5	28.6	33.3	35.6	35.5	35.1	32.4	32.2	33.3	35.9	32.9	28.8	32.5
2019	26.5	28.8	33.4	35.5	35.3	35.0	32.5	32.2	33.0	35.9	32.8	28.7	32.5
2020	26.6	28.8	33.0	35.3	35.3	35.2	33.6	32.3	33.1	35.7	32.7	28.5	32.5
2021	26.5	28.8	33.0	35.3	35.6	35.4	33.6	32.3	33.2	35.6	32.8	28.3	32.5
2022	26.4	28.6	33.0	35.4	35.7	35.5	33.9	32.4	33.3	35.5	32.6	27.9	32.5
2023	26.2	28.7	32.9	35.4	35.7	35.6	34.1	32.6	33.7	35.3	32.6	28.0	32.6
2024	26.0	28.7	33.0	35.1	35.7	35.7	34.0	32.4	33.9	35.0	32.7	28.0	32.5
2025	25.9	28.5	32.3	35.1	35.4	35.7	33.9	32.3	34.0	35.4	33.1	27.8	32.4

Source: Karachi Airport

As same as 20 years back data obtained which is showing great increasing impacts of Heat waves due to drought, less rainfall and high temperature. In addition, on the base of these impacts, data has been further revalue with the addition of average mean of 20 years back data. As a result, predicted data is derived and added. This data further based on 05 years as which can be shown also in each graphical figure according to month wise.

6.3.4 Floods

The purpose of this study is to make awareness about expecting threats and possibilities with respect to climate change for Karachi.

The following Floods (Run off) data and graphs of 30 year (1996- 2025) of Karachi shown in Table6.5.

Table 6.5. Mean Annual Precipitation (mm) (1996-2025)(PMD)

Annual Mean Precipitation (mm)	
Year	**Annual**
1996	99
1997	150.1
1998	82.4
1999	14.5
2000	46.9
2001	100.4
2002	55.8
2003	324.9
2004	65.9
2005	97.2
2006	301.1
2007	465.6
2008	121.6
2009	279.9
2010	372.9
2011	290.2
2012	152.1
2013	168.9
2014	30.7
2015	53.2
2016	111.7
2017	129.1
2018	135.0
2019	153.6
2020	184.9
2021	209.1
2022	222.4
2023	245.1
2024	214.4
2025	237.0

As same as 20 years back data obtained which is showing great increasing impacts of floods due to high temperature, less rainfall and drought and make cause of climate change. In addition, on the base of these impacts, data has been further valued with the addition of average mean of 20 years back data. As a result, predicted data is

derived and added. Derived data is showing tremendous effects of flood. This data further based on 05 years as which can be shown also in each graphical figure according to month wise. Flood Data also represented in graphical form to show impacts of it on climate. Data is showing highly impacts of heat waves as can be seen in figure: 4.41.

6.4 Result and Discussion on 05 Years Predicted Data calculated on the 20 Years Pervious Data and self-Monitoring Data.

Actually, Prediction gives on the base of present and past condition. It said to be a hypothetical data. It may be accepted or rejected. It is depend on past data and current data then formulate hypothesis about future.

Similarly, secondary data obtained from different sources which are 20 years old data. The data based on four factors i.e. Temperature, Drought, Heat waves and Floods rates in our study area. In this previous data, clearly shown the high influences of each factors, which means having negative effects on climate at that past time. After that, result obtained which directly reflect the almost highly intensity of given factors in forecast data.

In light of previous data, thoroughly analysis, sampling and monitoring of ambient air conducted as planned for this research study. The aim of sampling is to check and monitor composition of air that is responsible for climate. If there is any changes happen in composition of air, it may be effect on climate. For this purpose, air pollutants monitored as mentioned in study. Their highly values also showing the more affects air and indirectly effect the climate of study area.

As a result, all assessment of previous data, their factors and self-monitoring findings are opposite and highly impacted on climate of study area. Due to this unbalanced the components of air quality make a basic source of global warming as well as climate change. In study area, climate change is showing with high

temperature, peak of high temperature duration, less rainfall, excess of floods/run off etc.

6.5 Result and Discussion on 03 years Ambient Air Quality Monitoring Data (pre-monsoon and Post monsoon).

Air quality standards(Organization, 2010) are set by WHO and accordingly by Sindh (Idress et al., 2021) As shown in given Table. 4.6, ambient air quality is already effected as results indicates the values are exceeding as compare with the SEQS limits. Its means that analysed parameters concentration in air may be effected climate. As shown in given Table. 4.8 Similarly, ambient air quality is previously affected as results indicate the values are exceeding as compare with the SEQS limits. Its means that analysed parameters concentration in air may be effected climate within this area of research study. As indicated in given Table. 4.9, ambient air quality is already affected before Monsoon as results indicates the values are exceeding as compare with the SEQS limits. Its means that analysed parameters concentration of Suspended Particles in air may be affected climate.

As indicated in given Table. 4.10, ambient air quality monitoring data is showing impacts in Pre-Monsoon as results indicates the values are exceeding as compare with the SEQS limits. Its means that analysed parameters influence of Suspended Particles in air may be affected climate of that particular area of study area.

6.5.1 Ambient Air Data of Study Areas in Post-Monsoon Season (2017-2019)

As highlighted values in given Table. 4.11, ambient air quality monitoring data is showing impacts still in Post-Monsoon as results indicates the values are exceeding as compare with the SEQS limits. Its means that analysed parameters still influenced of Suspended Particles in air may be affected climate of that particular area of study area.

As highlighted values in given Table. 4.11, ambient air quality monitoring data is showing impacts still in Post-Monsoon as results indicates the values are beyond as compare with the SEQS limits. Its means that analysed parameters still influenced of Suspended Particles in air may be affected climate of that particular area of study area.

As highlighted values in given Table. 4.12, monitoring data is showing impacts in Post-Monsoon as results indicate the values are exceeding as compare with the SEQS limits.

As underlined values in given Table. 4.13, monitoring data is showing impacts in Post-Monsoon as results indicate the values are exceeding as compare with the SEQS limits.

6.6 Over All Review on Results and Discussion on Findings

As obtained results of all analysis, they are very impactful according to their inclusion, concentration and intensity. When data focused and evaluate obtained previous data to check out their intensity and impacts, the results found very high and seen big difference in all factor within 25 years of environment. After that, further evaluated data of next 03 years and result come with highly numbers. In this data process, 25 years back data placed as base and then evaluate next 03 years data.

Then put forward a predicted data, which totally based on previous data and 03 years of sampling data analysis. This data also showing high impacts that said to be a climate is affected as passage of time.

As same as, further self-monitoring of ambient air quality conducted from different areas within research study area. These sampling frequencies are Pre-Monsoon and Post-Monsoon seasons. Before and after same highly effected results found which show climate is changed.

6.6.1 Findings Based on Results and Discussion

There is enlist of finding on based on results and analysis of data:

- Results show temperature of all study areas is increasing day by day, which make cause of climate change.
- Derived from results that temperature is increasing gradually day by day is basic reason of climate change. Results showing 1.5°C increasing within 20 years and going on.
- Increasing of drought in study areas showing impacts of climate changes.
- Less rainfall or destabilize frequencies of rainfall also showing impacts
- Run off/Floods showing high melting of glaciers as well as unbalance of water cycle means indirectly impacts on climate.
- Components of air quality also disturbed due to the unbalancing of elements, which are analysed in study.
- The main reasons of unbalance of elements in air are anthropogenic factors as well as natural.
- Anthropogenic or natural factors effect on atmosphere as a result air quality becomes poor and climate change happens.

- Through these said factors` pollutants enter in air and create disturbance in balance of elements and in result obtain climate change occurrence.

Chapter 7

CONCLUSION

7.1 Conclusions on the Base of Results and Conditions of Air Quality of Research Study Areas

Climate change and anthropogenic factors modify hydrological sequence progression, thus causing change in climate patterns. River flow, the most important constituent of hydrological sequence experiences variation which is expected to be prejudiced by climate change and anthropogenic activities (Colbeck et al., 2010). The entire world is now confronting the horrendous effects of environmental change. The environmental change, impacted by expanding arrival of harmful gases in the air, untreated modern squanders in the waters and least consideration about factors that add to environmental change. The excessive global emission of greenhouse gases (mainly carbon dioxide, CO_2 and methane, CH_4), especially due to the burning of fossil fuel for energy and power generation, is the main cause to the air pollution and greenhouse effect. This has eventually brought many issues, such as climate change and global warming that will affect the standard life of human beings. Many strategies have been proposed to further reduce the excessive emission of greenhouse gases, including CO_2 and CH_4 utilization. This method not only reduces the CO_2 concentration in the atmosphere, but also producing renewable energy at the

same time. Hence, CO_2 and CH_4 utilization is also a promising approach to assist in overcoming the energy crisis due to the increasing population in time. Basically, the utilization of CO_2 and CH_4 system can be categorized into four:

i. Electrochemical reduction,
ii. Advanced catalyst system,
iii. Photo catalytic reduction, and
iv. In this review paper, the mechanism implemented on the four abovementioned categories and their respective limitations are presented. Besides, future recommendations to optimize the greenhouse gases utilization system for up-scaling purpose is also highlighted (LokeShowe, 2020).

There are some major aspects through them conclusion can be derived.

7.1.1 Temperature

In this study, evaluated data clearly shows the impacts of temperature is growing year wise as 1.5°C in 20 years back and 0.4°C in three years. In the light of these increasing numbers, can be estimated and concluded impacts that may be high or low temperature values in future six years. On the other hand, data is also presenting influences of temperature, which increasingly. It will be increased in further next 06 years means values. Moreover, these gradually increasing values in temperature make source of Global warming and climate change.

7.1.2 Drought

Drought caused due to less rainfall during a season or year, which might be less than expected per annually. Droughts might either be quick and protracted. Sensible managing of water assets, in phrases of assembly the source and call for hole can substantially decrease the viable detrimental influences of a drought upon us and at the surroundings.

- As study area, Karachi already faces a disproportionate population increase due to immigration and many other reasons, the pressure on resources leading to depletion. Moreover, the rainfall events are shrinking and the influences of probable drought duration might be intense. However, the potential of the supplier company to satisfy the viable concerns can be a better purpose of difficulty.
- It is observed that drought`s impacts increase respectively on each month. It is a major factor of climate change. Due to less rainfall, drought condition increases. It is inversely proportional to rainfall. In addition, rainfall rate directly affected on climate change.
- Due to drought condition, animals and human life will affect. Biodiversity is going to decline.
- If rainfall system will disturb, as a result all environment will be affect. Due to this, crop yield will disturbed and as a result, scarcity condition can produce.

7.1.3 Floods

The purpose of this study is to make awareness about expecting threats and possibilities with respect to climate change for Karachi.

- As in results and discussion, previous back data obtained which is showing great increasing impacts of floods due to high temperature, less rainfall and

drought and make cause of climate change. In addition, on the base of these impacts, data has been further re-evaluated with the addition of average mean of pervious back data. As a result, predicted data is derived and added. Derived data is showing tremendous effects of flood. This data further based on further next coming years as which can show also in each graphical figure according to month wise.

- Floods or runoff totally based on changing in weather. When weather disturb by any factors even drought conditions, less rainfall or peak of temperature or long time duration heat waves, it is said to be a changing is also occurring in climate. As observed increasing of temperature, will be worst impact on environment. Due to that, glaciers melt and make cause of runoff and floods.
- If rainfall system will disturb, as a result all environment will be affect. Due to this, crop yield will disturbed and as a result, scarcity condition can produce.

7.1.4 Heat waves

As a study area, Karachi has been under attention to elaborate impacts of climate change. Karachi has an arid climate, although a moderate version of this climate. Karachi is located on the coast and as a result has a relatively mild climate. Karachi has two main seasons; summer and winter, while spring and autumn are very short.

- Summer season persists for longest period during the year. Karachi also receives the rains from July to September. The city enjoys a tropical climate encompassing warm winters and hot summers. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is northeasterly.
- The mentioned Heat waves (Maximum Temperature of the day/peak of Temperature) data and graphs of 20 year (1996- 2025) of Karachi as discussed.

- As same as 20 years back data obtained which is showing great increasing impacts of Heat waves due to drought, less rainfall and high temperature.

7.1.5 Anthropogenic Factors

Since passage of time, population is increasing rapidly. To meet population needs the numerous of industries, urbanization, deforestation and other anthropogenic factors are rapidly increasing. These are the source point of releasing of GHGs and Carbon Gases in atmosphere where these particles are reaction in air and as a result affect the air quality.

- As observed that anthropogenic factors like urbanization, industrialization, deforestation, transportation, over populations, chemical fertilization, burning of fossil fuels, greenhouse gases emission and emission of Carbons have tremendous impacts on component of air quality and in result found the harmful impact on climate.
- Through conduction of monitoring of ambient air quality, it noted that anthropogenic factors are taking badly share in change of climate.
- Use of Chemical fertilization as anthropogenic factor will destroy soil fertility, green belt as well as animal shelter.
- Due to burning of fossil fuels, emission of GHGs and carbons, natural water cycle, carbon cycle and nitrogen cycle will be disturbed.

Table 7.1. factors and effects

S.NO	Factors	Effect
1	urbanization, industrialization, deforestation, transportation, over populations, chemical fertilization, burning of fossil fuels, greenhouse gases emission and emission of Carbons	Degradation of air quality
2	conduction of monitoring of ambient air quality	Climate change
3	Use of Chemical fertilization as anthropogenic factor will destroy	Soil fertility
4	burning of fossil fuels, emission of GHGs and carbons	natural water cycle, carbon cycle and nitrogen cycle will be disturbed

7.1.6 Socio-Economic Effects

- If air quality of study areas remains content, then is no doubt it will also effect on socio-economic conditions; and its going on.
- In this severe condition of air that directly effects on climate, as a result we will face loss of crops, yield shortage, low GDP may happen accordingly.
- Human health will also affect in this conditions.
- Respiratory organs can be damaged due to suspended particles values noted in research study.

Chapter 8

FUTURE DIRECTIONS

Pakistan is among world top ten most populace country, country is facing number of calamities in terms of natural disasters such as water shortage for irrigation and domestic use in urban and rural areas. Economy and all public sector organisations of the country are suffering and total chaos inside a possible governance structure, can immensely hamper the efforts of future governments. The multiple daunting tasks ahead of the country will further reduce the efforts in the right direction distresses. The matter is evident from the floods and respires of the government and civil society. Organising humans and establishments for movement might then need setting the difficulty in a situation that may discover each application and urgency inside our greater making plans priorities.

A conversation on climate change edition ought to hence began with a conversation on in what way the climate change associated hazards in shape within different current risks and priority challenges as opposed to on the dangers that weather trade is carrying or might additionally carry. Weather exchange variation is all approximately selling correct progress and correct governance and on conveying all applicable participants beneath a commonplace platform for motion and management.

Government of Pakistan is trying its best to tackle climate change and adheres to all international commitments. Further country is facing extreme events in form of floods, heat waves and varied rain patterns. In line with international and national climate change policy following are recommended.

- Energy: country meets most of the energy requirement for growing population through depleting natural gas and furnace oil however Pakistan is not using Coal for its requirements thus have comparatively low carbon foot print. To further meet energy requirement country need to rely on hydropower which can also help in flood solutions and green energy solution like solar, which is abundant in the country. One way to generate can be use of municipal waste for energy production.
- Energy efficiency and conservation: this can be achieved through good governance and maximum use day light along with energy efficient tools and procedures.
- Transport: country transport resources are based on furnace oil and vehicles that are old and contribute to smoke, which needs conversion to electric vehicles and good working condition of road and rail transport.
- Town planning: construction industry is one of the booming sectors of the country, however the irregular use of construction sector is producing lots of pollution and they are adopted according to local weathers.
- Industries: Major industry in the country include textile, sugar, fertilizer cement petro chemicals etc. and add up to 6 % of GHG emissions in the country(Colbeck et al., 2010)
- Agriculture and livestock: this sector is a major GHG contributor of the country and being an agricultural country is quite understandable. Pakistan

needs further regulation and modernisation of this sector to reduce climate change.

- Carbon Sequestration and Forestry: deforestation is a major problem and the forest resources of the country are depleting quite quickly. To farther the climate change slogan major forestation efforts are needed.
- Capacity Building and Strengthening: keeping in view the socio and economic issues, country is not in position to spare resources and funds for climate change. Similarly brain drain is limiting the human resource for this purpose. Pakistan need to capacity building and strengthen in this regard.
- Public awareness, regional and International Corporation: Pakistan has to enhance and captivate the public and ask regional and International Corporation in this regard.

8.1 Strategic Framework

Climate change variation activities are tackled to meet already present cavities and inadequacies in main urban offerings consisting of delivery for sanitation, water, drainage, power efficacy, lodging and healthcare, prominence on Sustainable community delivery, and enhancing the monetary properly being of ostracised societies inside which processes for weather alternate adaptation are incorporated. That is what institutes as impact however to cope with the king a city resilient now not simply to regular dangers and meet a climate alternate context therefore is of making a metropolis vibrant city increase demanding situations normally. To meet possibly weather trade situations corn Weil governed with preparedness to lead to a strategically essential shift of not as a co benefit. This expertise can something separate instead incorporating thinking about weather exchange version as development framework as they relate to applicable coverage and techniques within the normal precise sectors and institutions.

8.2 Reforms

Even as developing and moving in the direction of devising a feasible approach for to be a participatory technique. The enforcing a weather alternate variation approach has cope with the impact, the main obligation for imposing guidelines to pacts of weather exchange in cities reposes with neighbourhood governments. For us this concern proposals the utmost essential venture of all.

Approximately 90% of town terrestrial is beneath community proprietorship, wherever lodging centres cannot be prolonged without the approval of holding agency, of which around 17 leading institutes. The metropolis authorities hold simplest 30.9% of the terrestrial. Whilst devolution might be one mission, the larger venture is the entire lack of organizational tool binding these dispersed things. (Ponzi & Iwasaki, 2014), Due to a form of motives, frequently political, the obligation and applicability of the nearby government Improvement establishments has been reduced to a stage that maximum expansion taking Vicinity beside the exterior regions is casual in nature broadly speaking thru terrestrial grasps.

Facility of offerings isn't approved for these settlements alternatively are retrieved illegitimately get into selecting public structure. Encounters, essentially political in environment with traditional, economic and societal reinforcements are creating the town and the related coverage system and advance strategies more disruptive and complex. So the primary task is to clear up encounters and area the metropolis government in a rightful vicinity of adopting the role of the guardians of the metropolis with the considered necessary volume and enthusiasm to expect that position efficiently. An amazing undertaking however a demand that is together Vital and pressing.

Whilst we develop to the official and technical components of weather variation than the primarily phase is of plotting the responsibilities to hand starting with a plotting of uncovered and prone public and belongings. It could be a venture

that might need operating with prospects, developments and interpreting them into design bodily influences (threat zones) and considering hazards to the human beings and resources positioned within. This will need a enthusiasm and ability to put money into studies and produce work with information on a regular basis.

Zone established methods is on been finished as an instance in London (Uk) and Bangkok (Thailand), the technique to weather exchange model making plans identify unique sectors that area Penning In London and Bangkok has been and with the delegation of duty to appropriate organizations plans to address each corporations. This calls for a monetary and technical ability to make the correct investments and interventions.

A few main divisions that might be recognized in Karachi can also encompass water and hygiene, drainage, lodging and terrestrial usage, transport and emergency reply, emergency medicinal drug, fitness carefulness, hearth offerings, law and order and many others. Although a important function needs to be performed through authority's institutions in implementing. Techniques for weather alternate version, achievement and flexibility can only be accomplished if all divisions of the city compass proper accurate to the domestic level are concerned and feature a part plotted out for them. Whilst the town authorities have to preferably be taking the lead organizing position, vital obligations in offering important research, management and facility providing assist should be offer by groups which include NDMA, PDMA, SUPARCO, NIO, Met branch, instructional institutions, KW'&SB, SEPA, emergency response businesses and so on.

At the other stage, tasks on the metropolis level for acquiring premier consequences need to merge with a surely aped out nationwide model application for motion (NAPA). Right here once more, a possibility occurs to plug the gaps within the weather variation coverage as it relays to the municipal framework and alteration consciousness on a critically. Severely vital could be supply of financing choices for executing. The demanding situations are numerous but greater behind schedule the action, the tougher it will get.

Evolving a weather variation adaptation method isn't a lead to itself. Its miles extra within the environment of a voyage that could develop because the

technological know-how round it evolve, new technological Improvements surface and the volumes and replies of governments and societies adjust to altering eventualities. Need to takings step one. The scope of theism examine might not permit working into the profounder planned features along with an in depth perception into important liabilities, the greater coverage and governance factors as they communicate to climate alternate version an identity of main shareholder institutes an a their feasible parts and obligations that effort may be left for a policy report this list of moves recognized may be taken into consideration as some goals for us the utmost crucial thing narrates further to developing enthusiasm a consent and a strategy to attain The end intention Sand that might be the emphasis of with any luck a complete weather trade version strategy for Karachi city.

The recommendations are widespread in phrases of figuring out environmental making plans regions preservation, consumption, confined regions. Nevertheless, First of all there are no supplies for allocating with any situations that might be associated with weather variation and furthermore, the degree to which the hints are being accompanied in phrases of finalized or deliberate coastal progress is some distance from high-quality.

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