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FOR MEMBERS ONLY

Pakistan Engineering Congress is a prestigious professional body established in 1912 dedicated, *inter-alia* to technical advancement of Science & Engineering in the country

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Pakistan Engineering Congress
(75th Session)

EDITORIAL

Fellow Engineers

Greetings and Good Wishes

SMOG

1. WHAT IS SMOG?

Smog is a type of air pollution caused by tiny particles in the air. The word comes from a mixture of the words 'smoke' and 'fog' and was first used to describe the hazy mixture of smoke and sulfur dioxide produced by the burning of large amounts of coal.[1]

Modern smog, however, is a type of air pollution derived from vehicular emission from internal combustion engines and industrial fumes, containing Nitrogen Oxides and Volatile Organic Compounds (VOCs) that react in the atmosphere with sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog.[2]

2. CAUSES OF SMOG?

a. Burning of agriculture waste- crop stubble burning

b. Emissions from vehicles- Experts consider that 60-70% cause of urban air quality degradation is due to vehicles

c. Poor implementation of environmental laws

d. Improper disposal of industrial waste

e. Brick kilns are considered as a major contributor to smog

f. Steel rolling mills and Cement factories are also amongst some of the contributors of smog.

3. WHAT ARE THE IMPACTS OF SMOG?

Safety and health risks

a. High ozone levels can irritate the respiratory system leading to coughing. These effects generally last for only a few days after exposure. But the particles in the smog can continue to damage the lungs even after the irritations disappear. Long term effects include cardiovascular diseases, lung cancer and skin cancer

b. Breathing difficulties and lung damage:

- Bronchitis, pneumonia and emphysema are some of the chronic lung conditions caused due to constant exposure to smog.

---

1 https://www.wonderopolis.org/wonder/what-is-smog

2 https://www.nationalgeographic.org/encyclopedia/smog/

c. Risk of Vehicular Accidents

- Smog may prevent the driver or flight controller from reading important signs or signals thereby increasing the probability of road accidents or even plane crash.

d. WHO (2016) has reported 59,241 deaths in Pakistan in 2012 due to air pollution? While the death toll due to $PM_{2.5}$ exposure was reported to be as high as 135,000 in 2015 (Cohen *et al.* 2017).

e. >5.88% of GDP or $47.8 billion is the estimated economic burden of air pollution in Pakistan.

4. WHAT ARE THE PREVENTIVE MEASURES THAT CAN BE TAKEN FOR SMOG REDUCTION?

a. Immediate ban on crop stubble burning especially in winters

b. Closure of brick kilns for at least three months and using of Zig Zag technology

c. Control the burning of green waste (i.e. leaves, grass clippings), by improved and timely waste collection

d. Immediate activation of EPA's air quality monitoring sensors. Creating awareness about the air quality levels among masses.

AQI	Air Pollution Level	Health Implications	Cautionary Statement (for PM2.5)
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk	None
51 -100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects	Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion
201-300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.
300+	Hazardous	Health alert: everyone may experience more serious health effects	Everyone should avoid all outdoor exertion

e. Installation of emission control technologies (scrubbers, desulfurization equipment etc.)

f. Plantation of pollutant absorbing trees

g. Stay indoors and keep windows closed

h. Drink plenty of water

i. Keep a face mask at all times

j. Keep young children and elderly inside
k. Seek immediate help if coughing does not stop
l. Turn off gas burners, heaters, cars, bikes
m. Washing of face and exposed parts of the body with water after outdoor exposure
n. Grass Plantation on road curbside to absorb particulate matter

Yours sincerely

(Engr. Tahir Anjum Qureshi)
Chief Editor

INTRODUCTORY REMARKS

By

ENGR. TARIQ RASHID WATTOO

PRESIDENT

PAKISTAN ENGINEERING CONGRESS

AT

WORLD ENVIRONMENT DAY ON SATURDAY, THE 22ND JUNE 2018 ON THE THEME OF "AIR POLLUTION"

Distinguished Guests,

Members of Pakistan Engineering Congress,

Fellow Engineers, Participant, Ladies and Gentlemen!

Assalam-o-Alaikum

Pakistan Engineering Congress has the distinction of commemorating World Environment Day every Year since 2007. So far 116-numbber of Technical Papers have been published and distributed complimentary to a vide segment of society, Libraries, concerned departments. This year the theme circulated worldwide is "Air pollution". The topic is well chosen in view of the following pertinent ground realities;

Air Pollution Facts:

- 92 per cent of people worldwide do not breathe clean air.
- Air pollution costs the global economy $5 trillion every year in welfare costs.
- Ground-level ozone pollution is expected to reduce staple crop yields by 26 per cent by 2030.
- It is fifth leading cause of death, approximately 7 million people worldwide die prematurely each year from air pollution with about 4 million of these deaths occurring in Asia-Pacific.
- Nine out of ten people worldwide are exposed to levels of air pollutants that exceed those considered as safe by the world Health Organization.

Ladies & Gentlemen!

Human Survival is at grave stake and what is striking is that it is all due to own making of the Human beings themselves.

- Abnormal rise in global temperature due to indiscriminate burning of fossil fuels a consequence of rising populations, unchecked commercialization at least 0.7 C increase in Global Temperature since 1980
- Un-planning, rising urbanization, expansion of cities, slums, buildings and absence of adequate infrastructure

- Mounting mounds of domestic, industrial, agricultural, hospital and electronic waste materials, burning of wheat, rice stubs even this practice in adjoining Indian Punjab results in heavy Air-Pollution
- Greenhouse Gas emissions by the buses, rikshaws, vehicles in particular using sb-standard low-quality fuels, Gas burning domestically, commercially, industrially as well as in generation of electricity
- Another kind of Air-Pollution is Smog which is a mixture of smoke and fog in the Air. It results from Coal burning.
- At least 25% of Greenhouse Gas Emissions are accounted by land cleaning, deforestation, fertilizers and crop production

What is the way forward:

- There are so many things that we can do. From cycling or walking to work and back, to recycling your non-organic trash, to pressuring your local authorities to improve green spaces in your city.
- Turn off lights and electronics not in use.
- Check efficiency ratings for home heating systems and cookstoves to use models that save money and protect health.
- Never burn trash, as this contributes directly to air pollution.
- China is vigorously cleaning-up Smog, choked skies
- Pollution Taxation

Ladies & Gentlemen!

We are Lucky to have amongst us luminaries of Environmental sciences and they will be presenting their Technical papers relating to Air Pollution both in National and International context and the way forward proposed will be conveyed to Federal/Provincial Govt. departments for adoption. Let us hear them.

Thank you all for your patient hearing.

PAKISTAN PAINDABAD

WORLD ENVIRONMENT DAY 2019 ON THE TOPIC OF "AIR POLLUTION"

The World Environment Day is celebrated on 5th June all the world over on the theme of the year.

The theme of this year was "Air Pollution" upon purity of which safety of health and life is dependent. In this connection proper safety standards have been laid down by World Health Organization and National Health Environmental Standards Organization.

Air Pollution Facts:

- 92 per cent of people worldwide do not breathe clean air.
- Air pollution costs the global economy $5 trillion every year in welfare costs.
- Ground-level ozone pollution is expected to reduce staple crop yields by 26 per cent by 2030.
- Approximately 7 million people worldwide die prematurely each year from air pollution with about 4 million of these deaths occurring in Asia-Pacific.
- Nine out of ten people worldwide are exposed to levels of air pollutants that exceed those considered as safe by the world Health Organization.

What is the way forward?

- Caring for existing plantation and growing new plants.
- There are so many things that we can do. From cycling or walking to work and back, to recycling your non-organic trash, to pressuring your local authorities to improve green spaces in your city.
- Turn off lights and electronics not in use.
- Check efficiency ratings for home heating systems and cook stoves to use models that save money and protect health.
- Never burn trash, as this contributes directly to air pollution and noise.

Due to the month of Ramazan the event was held on 22nd June 2019. It was presided over by Ch. Ghulam Hussain former President. He presented the welcome address. The chief guest was Engr. Khalid Javed Vice President/Chief Engineer Highway Department. 11 technical papers were presented by water experts, environmentalist, meteorologist, educationists. After the technical session Questions/Answers session was held. Congress shields were presented to the speakers by the chief guest. It was a very well attended event.

GLIMPSES OF WORLD ENVIRONMENT DAY



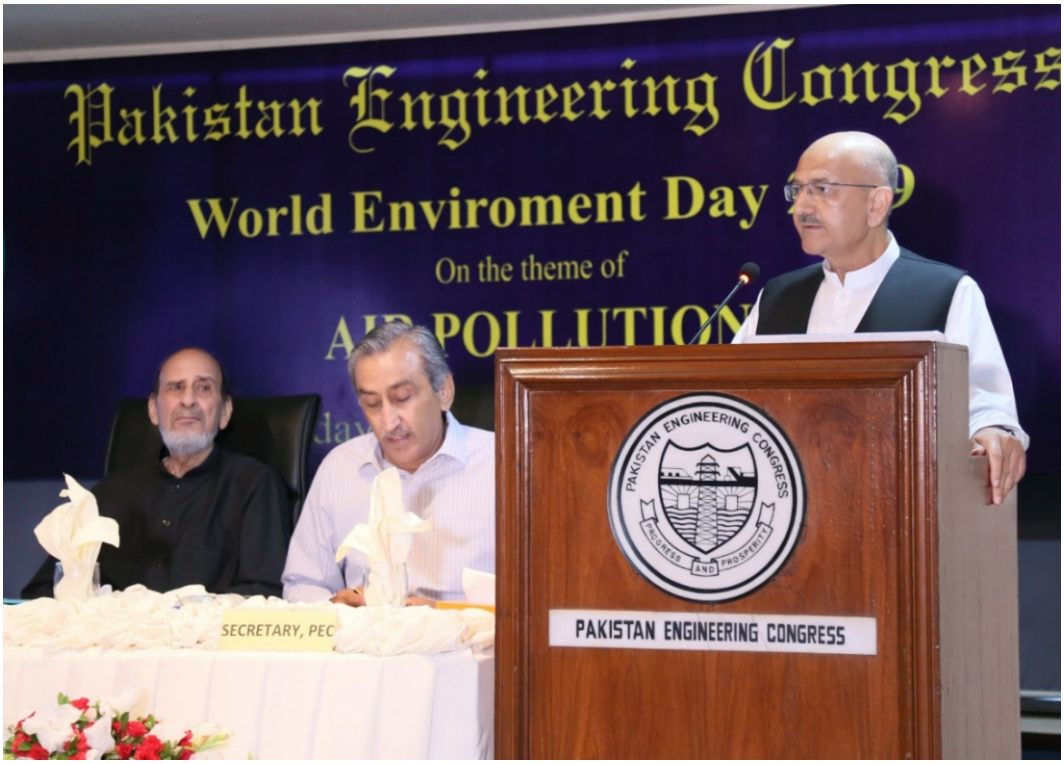
(From Left) The Chief Guest, **Engr. Khalid Javed,** Vice President PEC/Chief Engineer Highway Department Punjab, Engr. Ch. Ghulam Hussain, Immediate Past President PEC, Engr. Najam Waheed, Secretary PEC



Engr. Najam Waheed, Secretary PEC presenting the Program of the Event



Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting the Introductory Remarks



The Chief Guest, **Engr. Khalid Javed** presenting his over-view of the Presentations on
"Air Pollution" at the Eve of World Environment Day 2019



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Mr. Ahmad Rafay Alam for his presentation on the topic of **"Air Quality Challenges"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Mr. Muhammad Riaz, Director General Metrological Department, for his presentation on the topic of **"Smog A Major Environmental Hazard"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Ms. Ifrah Kamil for her presentation on the topic of **"Understanding the Relation Between Polluted Water and Solid Waste with Air Pollution; Establishing a Case for Lahore"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Prof. Dr. Asad U Khan, PhD, for his presentation on the topic of **"Addressing the Pakistan Air Pollution Crisis: Academia-Industry-Government Role"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Ms. Burera Khush Bakht for her presentation on the topic of **"Lahore Ambient Air Pollution: Main Root Causes and Impacts on Public Health – A Detailed Review"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Ms. Mahnoor Iftikhar for her presentation on the topic of **"Lahore Ambient Air Pollution: Main Root Causes and Impacts on Public Health – A Detailed Review"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Mr. Ihtesham ul Haq for his presentation on the topic of **"Air Pollution from Burning of Hospital Waste by Incinerators"**



(From Left) The Chief Guest **Engr. Khalid Javed** and Engr. Ch. Ghulam Hussain, Immediate Past President PEC presenting shield to Ms. Nabeeha Lodhi for her presentation on the topic of **"Occurrence of Respiratory Disease Due To Ambient Air Pollution in Lahore"**



(From Right) **Engr. Ch. Ghulam Hussain,** Immediate Past President PEC, presenting shield to The Chief Guest **Engr. Khalid Javed**



Media Talk with The Chief Guest Engr. Khalid Javed



Media Talk with Engr. Ch. Ghulam Hussain, Immediate Past President PEC

GLIMPSES OF THE AUDIENCES





GLIMPSES OF THE AUDIENCES





SCHOLARSHIP PROGRAM OF PAKISTAN ENGINEERING CONGRESS

Pakistan Engineering Congress instituted 100-Scholarships of Rs. 4000 per month for Graduate Studies for four-year period as under so far 66- Scholarships have been awarded:

University of Management, Lahore	01
Quaid-e-Awan University (QUEST) Nawabshah	01
COMSATS University Islamabad	01
NED Karachi	01
Government College University, (GC) Lahore	01
The Islamia University Bahawalpur, Bahawalpur	01
University of Swat, Swat	01
University of Lahore, Lahore	02
Mehran University of Science & Technology	02
Bahauddin Zakariya University, Multan	02
University of Engineering &Technology Peshawar	03
Balochistan University of Information & Technology, Engineering and Management Sciences	03
Lahore College for Women University, Lahore	03
Mehran University of Engineering & Technology	03
National University of Science & Technology Islamabad	03
Balochistan University of Engineering &Technology Khuzdar	04
University of Engineering &Technology Peshawar	05
Khawaja Fareed University of Engineering and Information Technology	06
University of Engineering & Technology Lahore	23
	66

Disbursement of Scholarship funds to the students have been made in amount of Rs. 24000 each for the period of April 2019 to September 2019, a total amount Rs. 15.84 Lac. The cheques were distributed in a ceremony held on Saturday, June 22nd, 2019 at Congress Headquarters by Engr. Iftikhar Ahmed Past President /Convener of Welfare Engineers Committee.

Pictures of the ceremony are appended

GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY



GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY



GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY



GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY



GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY

















GLIMPSES OF SCHOLARSHIP CHEQUES DISTRIBUTION CEREMONY



REHABILITATION AND UPGRADING OF TRIMMU BARRAGE

Technical visit of the delegation of Pakistan Engineering Congress to Trimmu Barrage project was made on 31st August, 2019.

A 23 members strong delegation of Pakistan Engineering Congress comprising senior engineers/ young professionals led by Engr. Capt. (R) M. Qadir Khan, joint secretary visited to Rehabilitation and Upgrading Project of Trimmu Barrage on 31st August, 2019. Upon arrival the delegation was given a brief on the salient features of the project followed by field tour of the project. At the conclusion of the visit, a shield/set of Congress publications were given by Engr.Capt.(R) M. Qadir Khan to Engr. M. Saleem Pirzada. Some of the pictures of the visit are attached.

A report on the main features of the rehabilitation and Upgrading of Trimmu is given below:

INTRODUCTION:

Trimmu Barrage is located downstream of the confluence of Jhelum and Chenab Rivers and was commissioned in 1939. Three canals offtakes from the Trimmu Barrage i.e. Haveli, TS Link and Rangpur Canal. The Barrage was lastly remodeled in 1962 by adding a new head regulator for the Trimmu-Sidhnai Link Canal to supply water to Lower Ravi and Sutlej River Commands. The Barrage irrigates a CCA of 2.68 Million acres (13.19% of the Punjab Total CCA) through its off taking canals. The present safe discharge capacity of the Barrage is 450,000 cusecs.

OBJECTIVE OF THE PROJECT:

The main objectives of the project include the followings:

- Enhancement in the Existing flood discharge capacity of the Trimmu Barrage from 450,000 cusecs to 875,000 cusecs for passing 100-years return period of flood discharge determined through hydrological analysis.
- Rehabilitation and Upgrading of Existing Barrage and its ancillary works, enabling to perform design functions.
- Partial removal of shoal (Bela) upstream of Barrage to steady River flow.

CONTRACT SALIENT FEATURE:

- Project Name : Rehabilitation and Upgrading of Trimmu Barrage
- Donor Agency : ADB and Govt of Punjab
- Employer : Irrigation Department Govt of Punjab
- Consultants : JV of NESPAK, EGC and SMEC
- Contractor : M/S Sino hydro Co. Ltd
- Contract Amount : PKR. 9,360,100,000

- Commencement Date : May31, 2016
- Original Duration : 1095 days
- Scheduled Completion Date : May30, 2019
- Defect Notification Period : 365 days
- Physical Progress : 87%

SCOPE OF THE WORK:

- Construction of 13 additional bays for capacity enhancement of the Barrage
- Rehabilitation of Existing Barrage structures.
- Removal of shoal formation (Bela).
- Construction of new Head Regulator for Rangpur canal along with Silt Excluder.
- Construction / rehabilitation of Infrastructure and buildings
- Raising and strengthening of River Training Works.
- Replacement of the gates and hoisting system.
- Installation of local and central control system for barrage operation.
- Installation of piezometers.







Briefing about Trimmu Barrage.



Shield Presented to Engr. Muhammad Saleem Pirzada. Chief Engineer Electrical (NESPAK)



Congress Publications Presented to Engr. Muhammad Saleem Pirzada. Chief Engineer Electrical (NESPAK)



Shield Presented to Engr. Muhammad Saleem Pirzada. Chief Engineer Electrical (NESPAK)



Congress Publications presented to Engr. Rana Muhammad Kashif (SDO)



Group Photo of Pakistan Engineering Congress Delegation at Trimmu Barrage.

WORK ON HUB COASTAL OIL REFINERY TO START THIS YEAR

Project will have the capacity to produce 250,000 barrels per day

The government is set to perform the groundbreaking of the much-delayed multibillion dollar coastal oil refinery by end of this year – a project having the capacity to produce 250,000 barrels per day (BPD).

The Pak-Arab Refinery Limited (Parco) has proposed to establish the state-of-the-art coastal refinery in Hub, Balochistan at an estimated cost of over $5 billion.

"Under the project, expected to be completed by the end of 2023, around a 250,000 BPD oil will be refined, which is equal to 13 million tonnes of petroleum products per year," a senior official told APP.

Around 1,000 acres of land had been allotted for the project. The allotment was approved in October 2007 but remained suspended because of shortage of finds.

Terming the project a significant step towards achieving self-reliance in the oil production sector, the official said the government was making all-out efforts to upgrade the existing oil refineries and establish new deep conversion facilities for meeting the country's fuel requirements in a smooth manner.

Steady Rise 12.8% is the Increase witnessed in the country’s domestic production of crude oil from July to March in the last fiscal year in comparison with the same period in 2017-18.

The country's domestic production of crude oil has witnessed around 12.8% increase during a nine-month period (July-March) of the last fiscal year in comparison with the same period in 2017-18.

The domestic production of crude oil stood at 24.6 million barrels against 21.8 million barrels in 2017-18. The county's average annual oil consumption is around 26 million tonnes, of which 13.5 million tonnes is met through local production of eight existing oil refineries while 50% crude oil is imported to meet energy needs.

Answering a question, the official said an unprecedented incentives package was in place for setting-up new deep conversion oil refineries, enabling them to import machinery, vehicles, plants and equipment. Another state-of-the-art oil refinery and petrochemical complex was being established at Gwadar deep seaport city, an ultimate destination of the China-Pakistan Economic Corridor (CPEC), with around $11 billion Saudi investment.

Pakistan and Saudi Arabia have also agreed to establish a joint working group (JWG) for timely and smooth execution of the project, which has tremendous potential to capture markets in China and Central Asian landlocked states where fuel supply takes weeks to reach through other routes.

The official said the JMG would hold regular interaction to exchange information needed to carryout feasibility studies of the project on a fast track.

Under the OPEC route, he said, the fuel transportation to China via Pakistan would take just seven days as import through western China takes almost 40 days.

The official said the mega oil facility, having capacity to refine 200,000 to 300,000 BPD oil, would also help refine and store imported oil for onward transportation to China and develop fuel supply chain for the land-locked Central Asian states. He expressed confidence that with establishment of the modem oil refineries and petrochemical complex, there would be a significant reduction in the country's oil import bill. APP

OBITUARIES

July 2019 to December 2019

Fateha for the Departed Souls

1. **Mr. Ch. Mushtaq Ahmad**, Brother of Engr. Ch. Ghulam Hussain Immediate past President of Pakistan Engineering Congress passed away in Samundri, Faisalabad on Sunday, The 7th July 2019.

2. **Engr. Capt. (R) Syed Khalid Sajjad,** Chief Engineer (Power WAPDA) Principal WAPDA Academy Chairman, IEP Local Center Lahore passed away after performing Umrah on 15th March 2019.

3. **Mother of Engr. Syed Nafasat Raza**, Member Executive Council / treasure Pakistan Engineering congress and Additional Secretary Communication and Works. Department Punjab passed away on December 5, 2019 and buried at Jangh.

CLIMATE CHANGE MAKES JULY HOTTER BY UP TO 3 DEGREES C

Experts say trend will bring increasingly severe heatwaves and heavier downpours

PARIS: The record-shattering heatwave that baked much of northern Europe last month was likely between 1.5 to 3.0 degrees Celsius hotter due to man-made climate change, an international team of scientists said on Friday.

The three-day peak saw temperature records tumble in Belgium, the Netherlands and Britain while the city of Paris experienced its hottest day ever with the mercury topping out at 42.6C (108.7 Fahrenheit) on July 25.

The ferocious heat came off the back of similar soaring temperatures in June, helping that month to be the hottest June since records began.

Scientists from the World Weather Attribution (WWA) team combined climate modelling with historical heat-wave trends and compared it with monitoring data across the continent.

They concluded that the temperatures produced by the climate models were as much as 3C (5.5 degrees Fahrenheit) lower than those actually observed during the heatwave in Europe.

"In all locations an event like the observed would have been 1.5 to 3C cooler in an unchanged climate," the WWA said, adding that the difference was "consistent with increased instances of morbidity and mortality".

Global warming also made the July heatwave in some countries between 10-100 times more likely to occur compared with computer simulations.

Such temperature extremes in northern Europe, without the additional 1C centigrade humans have added to the atmosphere since the industrial era, would be expected on average once every 1,000 years.

Michael Byrne, lecturer in Earth and Environmental Sciences at the University of St Andrews, said the analysis had "found the fingerprints of climate change all over (last month's) extreme temperatures".

"We know without doubt that climate change will bring increasingly severe heatwaves, but also heavier downpours and more flooding," added Byrne, who was not involved in the research.

The July heatwave caused widespread disruption, prompting train cancellations and emergency measures in many cities.

The June heatwave itself was likely made at least five times more likely by climate change, and was around 4C hotter than an equivalent heatwave a century ago.

Europe has experienced exceptionally intense heatwaves in 2003, 2010, 2015, 2017, 2018 and two this year, peaks consistent with the general warming trend: the four hottest years on record globally were the last four years.

The World Meteorological Organisation (WMO) on Friday said that preliminary data showed July may have been the hottest month ever recorded.

Temperature readings and data provided by the European Union's Copernicus monitoring service showed that the first 29 days of July 2019 were equal to or possibly warmer than the hottest month ever, currently July 2016.—AFP

HIGH-RISES ILL-EQUIPPED TO BATTLE FIRES

MUHAMMAD SHAHZAD
LAHORE

Community response teams find most buildings lack necessary safety measures

Fire safety seems to have taken a backseat for many a year when it comes to the construction of high-rise buildings in the provincial capital.

A survey of 250 high rise-buildings, conducted by Community Emergency Response Teams (CERT), reveals that emergency staircases are missing in 29 of such structures, while 12 lack fire doors. In addition, there are no hydrant systems in 24, fire-extinguishers in 152, fire alarm systems in 55, evacuation plans in 33 and response teams in 25.

A source tells The Express Tribune that all these 250 buildings are occupied and none of them have been comprehensively following fire safety protocols. The Civil Defence Department has declared the presence of a fire detection and alarm system mandatory. Also mandatory are fire extinguishers, hydrants and sprinklers. Such buildings require a fire safety plan, emergency fire control room, emergency exit and evacuation plan as well as ventilation and conditioning systems on the premises.

Evacuation drills at regular intervals and their records are also part of the prescribed safety measures.

The source continue that CERTs have been established at the union council level, under a community safety programme, to promote a sense of awareness and build a liaison with stakeholders to enable the effective dealing of an emergency situation.

The survey was conducted internally and the stakeholders were promised that their building names would not be revealed. He adds that these gaps have been identified on different forums. However, the issue still persists. The shortcoming of fire safety measures persists in buildings varying from plazas, commercial centers to public sector establishments.

He also confirms that fire safety systems in the mentioned 250 buildings are not up-to par. The violations of these safety rules were exposed in some fire incidents which occurred in high-rise buildings.

The loss and casualties in the notorious Lahore Development Authority (LDA) plaza fire of 2013 were increased due to the lack of necessary counter measures. The same negligence caused many a hurdle in the rescue operation.

In another incident, several people had to jump off the building to save their lives in the Cold Mines Plaza fire in Ichra a few years ago. One of the victims was reportedly killed after he was forced to jump out despite attempts to make it down to the ground and out of the building. Another major fire was one which took place last in Ali Tower situated in the Gulberg area.

What is an ideal safety system?

A community safety officer shares that an idea fire safety system is one which has smoke detectors attached to an automatic alarm system. He says a sprinkler system is a must and should include fuses placed on water taps which automatically erupt when the temperature rises above a certain level.

"This works even if a door is locked and nobody is inside." He continues that a firefighting system will be automatically enabled with such equipment in place. He emphasises that every building plaza should have its own firefighting system with standby water storage and alternate power supply like generators. The officer points out that these measures are necessary as they do not require rescue vehicles to travel long distances for refilling of water.

"There should be a proper evacuation exit and plan. These should be marked and visible even in the absence of power. Also, emergency drills, in compliance with the evacuation plan, must be conducted at regular intervals," he stresses. He suggests that the records of the mentioned drills be meticulously maintained.

The officer reveals that a fire extinguisher system is the least favorable measure or perhaps even the least effective in these modem times. He says fire spreads quickly and extinguishers take time in emergency situations.

CDWP MAY APPROVE 'FIRST PROJECT' TO SUPPLY POTABLE WATER TO LAHORE

By

Khalid Hasnain

LAHORE: The Central Development Working Party (CDWP) is likely to approve today (Tuesday) the Lahore's first Water and Wastewater Management Project construction of clean drinking water treatment plant near Bambawala Ravi-Bedian (BRB) Canal.

Under the project, the Water and Sanitation Agency (Wasa) will ensure provision of clean drinking water to around 1 million consumers (approximately 10m people) living in north Lahore, especially those residing in localities near the GT Road, including Baghbanpura, Mughalpura and Shadi Pura, after treatment of 100 cusecs of canal water from BRB that will be made available by the irrigation department.

'Since the Provincial Development Working Party (PDWP) of the planning & development department had approved this Rs19.9 billion project in March, this year, the Punjab government forwarded it to the federal government in June for approval. So, now, this project will be taken-up by the central development working party (CDWP) in its meeting to be held on Sept 3, on Tuesday (today) in Islamabad. And we are much hopeful that the CDWP would approve this and send it to the Executive Committee of National Economic Council (Ecnec) for final approval,' a senior Wasa official explained while talking to Dawn on Monday.

Envisaged by Wasa about two years ago, the Punjab and federal governments had approved its project concept-I (PC-I) during the last quarter of 2017. After approval, the PC-1 was shared with the Asian Infrastructure Investment Bank (AIIB) that finally agreed to fully fund it through a soft loan. Later, the pace of work on the project's approval by the Punjab government for its execution slowed down because of the pre-election political uncertainty in 2018. Similarly, it remained slack during the whole year since the new government took time to understand the routine business of the government. However, it finally took up various pending issues and its PDWP approved this important project in March 2019. It had sent the project to CDWP (federal government) for approval in June, this year. And finally the CDWP included it in agenda items of its meeting scheduled to be held on Tuesday (today).

Besides this, the project was stalled since long as the authorities thought its cost could be reduced if Wasa was supplied water from the BRB Canal at Batapur rather than its point situated across the River Ravi. But, later, the department in January, this year agreed to allow Wasa to get the canal water from the Batapur (GT Road) that reduced the cost of laying of 7km-long or so pipelines. The department had earlier selected the canal's point that comes after crossing of the Ravi but the experts went against it and suggested Batapur point.

‘Of the total cost (Rs19.9 billion), Rs.5 billion would be given to irrigation department for making arrangements to supply water to the treatment plant, which would be established at Bhaini village (near Batapur) after pumping it out from the BRB Canal.

The department would also get some repair/upgradation work done at Siphon within this budget. The remaining Rs.14.9 bn would be spent for establishing new infrastructure (laying pipes, new connections etc),’ the official added.

To a question, he said over 33 litres of the treated water would cost Rs1 to Wasa but the agency would supply 100 litres of drinking water to the consumers on subsidized rates of Rs1. The approximate quantity to be supplied to consumers through the new arrange-ment would be 50 million gallons per day, he claimed. To another question, he said the water to supplied would be just like mineral water and would contain certain amount of chlorine. There would be no chance of presence of arsenic in that water, he claimed.

‘The new arrangement would also reduce burden on the tube-wells supplying water to the people in the target areas. Once this project becomes functional, the tube-well operation would squeeze to one hour only from 14-16 hours daily. The tube-wells would only be operated for 12-14 hours during December and January (21 days) during the canal’s closure for annual desilting campaign. Similarly, it would help us control the depletion of underground water,’ the of ficial maintained.

Talking about Phase-2 of the project that would focus on the areas near Thokar, he said Wasa would not only supply clean drinking water to a large population living in southern Lahore, but also ensure return of 100 cusecs to the irrigation department after treatment of the 100 cusecs of sewage or wastewater.

For this purpose, a water treatment plant would be installed at Qatar Band Road (near Thokar) where Wasa would treat 100 cusecs of wastewater and then put it into the Lahore’s main canal. ‘In this way we will return the water we would get from irrigation department, he added.

INDONESIA TO MOVE ITS CAPITAL TO BORNEO ISLAND



JAKARTA: Indonesia will move its capital to the eastern edge of jungle-clad Borneo island, President Joko Widodo said on Monday, as the country shifts its political heart away from congested and sinking megalopolis Jakarta.

The proposed location near the regional cities of Balikpapan and Samarinda is an area at 'minimal' risk of natural disasters, where the government already owns some 180,000 hectares (445,000 acres) of land, he added.

'The location is very strategic, it's in the centre of Indonesia and close to urban areas,' Widodo said in a televised speech.' The burden Jakarta is holding right now is too heavy as the centre of governance, business, unance, trade and ser-vices,' he added.

The announcement ends months of speculation about whether Widodo would follow through on the long-mooted plan which was floated by the newly independent country's founding father Sukarno more than half a century ago.

Shifting from problem plagued Jakarta would also transfer Indonesia's power base of Java island, where about half of the sprawling archipelago's 260 million people live.

'Moving the capital off Java is a gesture that aims to solidify unity,' said Jakarta-based political risk analyst Kevin O'Rourke.

'Jakarta will continue to be a megacity as a centre for finance and commerce for a few more decades, but ultimately it is at severe risk to climate change,' he added.

A bill for the proposed move will now be presented to parliament, Widodo said.

Building is set to begin next year with the move of some 1.5 million civil servants slated to begin by 2024, at a cost of 466 trillion rupiah ($33 billion), of ficials said.

Orangutans, mining Known as Kalimantan, Indonesia's section of Borneo –the island it shares with Malaysia and Brunei is home to major mining activities as well as rainforests, and is one of the few places on Earth with orangutans in their natural habitat.

Environmentalists expressed concerns the capital city move could threaten endangered species.

'The government must make sure that the new capital is not built in a conservation or protected area,' said Green peace Indonesia campaigner Jasmine Putri.

The region has also been blanketed in choking haze from annual forest fires that ravage vast swathes of land.

'That makes Kalimantan unfit as a candidate for a new capital city,' said Jakarta based urban planning expert Nirwono Joga.

'And the move won't necessarily free Jakarta of problems like flooding, traffic jams and rapid urbanisation,' he added.

Concerns have soared over the future of Jakarta a city nicknamed the Big Durian after the pungent, spiky fruit that deeply divides fans and detractors.

Built on swampland, the city is one of the fastest-sinking cities on earth, with experts warning that one third of it could be submerged by 2050 if current rates continue. The problem is largely linked to excessive groundwater extraction.

But the city of 10 million, a number that bloats to about 30 million with surrounding satellite cities, is also plagued by a host of other ills, from eye watering traffic jams and pollution to the risk of earthquakes and floods.

Indonesia is not the first Southeast Asian country to move its capital.

Myanmar and Malaysia have both moved their seat of government, while Brazil, Pakistan and Nigeria are among the nations that have also shifted their capital cities.-AFP

CENTRE ANNOUNCES RS.125 BILLION SINDH BARRAGE PROJECT

By:

Imran Ayub

KARACHI: The federal government announced on Friday an ambitious Rs.125 billion Sindh barrage project on the River Indus, winning support from the provincial government to build a huge project on the River Indus, winning support from the provincial government to build a huge structure 45km from the sea in the South of Thatta and east of Karachi to address environmental issues of sea intrusion and land degradation.

The unusual consensus between the ruling Pakistan Tehreek-I-Insaf at the Centre and the Pakistan Peoples party in Sindh was reached at a meeting presided over by chief Minister Syed Murad Ali Shah at the CM House. It was attended by a federal government delegation led by Minister for Water Resources Faisal Vawda, Water and Power Development Authority (Wapda) Chairman retired Lt Gen Muzammil Hussain and senior officials from both sides.

'The project would cost around Rs.125 billion,' said Mr. Vawda while talking to reporters after the meeting.

'We are quite sure that the prime minister will approve the funding.

The good thing is that during the meeting the Sindh Chief Minister also agreed to share the cost if we need that in case of shortage from the Centre. But right now we are very much hopeful that the federal government would bear the cost of this project,' he added.

Earlier, a statement issued by the CM House after the meeting said the two sides had agreed to work for development of the country, resolve the water crisis in Sindh and lay foundation for welfare of the region as the project would meet the needs for the next several decades.

'Due to non-availability of water downstream Kotri sea intrusion has destroyed hundreds of villages in Thatta and Sujawal districts and badly affected the delta,' the statement quoted CM Shah as saying during the meeting. 'As a result, wetland habitats, mangroves and marine life growth have not only come to a standstill but also vanished to a large extent. Hundreds of families have migrated from the areas in search of livelihood somewhere else,' it added.

Mr. Vawda and the Wapda Chairman, while briefing the chief minister, said Indus was the largest river and lifeline of the country's agricultural economy.

'Indus River flows with mild gradient one metre per 18km. Downstream Kotri annual flows have been recorded at 27.9 MAF (million acre feet) to the sea. Flood protection bunds exist on both banks of Indus River stretch and the flood plain is 8-12 km,' the meeting was informed.

According to the statement, the Wapda chairman told the meeting that there was a plan to construct a 12-metre high Barrage on the Indus at a distance of 45 km from the sea. He said that dykes on both banks in flood plain would be four to nine metres high and the reservoir in flood plain from the barrage would be 160 km upstream, adding that there would be two canals on each side for irrigation and drinking water in the coastal area.

Mr. Hussain said the Right Bank Canal (RBC) would be constructed from Ghorabari to Gharo and the Left Bank Canal (LBC) from Sujawal to Golarchi.

At this, according to the statement, the chief minister suggested that the RBC should be built up to Dhabeji so that it could provide water to Karachi and the LBC should be constructed from Golarchi to Thar to provide drinking water to the people to Thar.

The Wapda chief told the meeting that around 56,500 acres of land would be acquired for the prupose 55,000 acres for flood plain, 700 acres for the RBC and 800 acres for the LBC.

The Chief Minister was of the opinion that since both the canals would be taken up to Dhabeji and Thar, 80,000 acres of land would have to be acquired.

The meeting was told that a conceptual study by Wapda has been completed, while feasibility study would be done by September 2020, vetting by international consultants by December 2020 and detailed engineering design by 2021. Construction work on the project would start in January 2023 and it would be completed by December 2024.

GEO-ENGINEERING: 'PLAN B' FOR THE PLANET AMID CLIMATE EMERGENCY

Agencies

"Plan A" remains tackling the problem at its source. But the UN's top climate science body has made it clear that slashing carbon pollution won't be enough to keep Earth from overheating.

That has opened the door to a host of geo-engineering schemes, and an under-the-radar set of global industry guidelines, currently in review, which could help mainstream them.

Here is a menu of "Plan B" geo-engineering solutions, and their potential drawbacks:

Direct CO_2 capture

Experiments have shown it is possible to suck planet-warming carbon dioxide directly from the air, converting it into fuel pellets or storing it underground.

A Canadian company backed by Microsoft co-founder Bill Gates launched a pilot facility in Canada in 2015, and another company unveiled one in Iceland last year.

DRAWBACK: The technology is currently prohibitively expensive and may take decades to operate at scale.

Afforestation

Extensive planting of trees could significantly slow the concentration of CO2 in the atmosphere, which currently stands at more than 410 parts per million, 40 percent more than 150 years ago.

DRAWBACK: Even if deforestation could be reversed — more than 100,000 square kilometres of tropical forests have disappeared each year since 2013 — the number of trees needed to put a dent in CO2 emissions would clash with food and biofuel crops.

BECCS

Bioenergy with carbon capture and storage (BECCS) marries a natural process with a high-tech one.

The first step is to plant rapeseed, sugarcane, corn or "2nd-generation" biofuel crops such as switchgrass, which pull CO2 from the air while growing. The second step is while burning the harvested plants for energy to sequester the CO2 produced.

In theory, the result is less CO2 in the atmosphere than when the process started. Virtually all climate change models projecting a future consistent with the Paris Agreement's temperature targets assume a key role for BECCS.

DRAWBACK: Studies calculate that up to twice the area of India would need to be given over to biofuels, putting BECCS in conflict with food crops.

Ocean fertilisation

Microscopic ocean plants called phytoplankton gobble up CO2 and drag it to the bottom of the ocean when they die. Their colony size is limited by a lack of natural iron, but experiments have shown that sowing the ocean with iron sulphate powder creates large blooms.

DRAWBACKS: Scientists worry about unintended impacts. Die-offs of plankton, for example, use up oxygen, which could create massive “dead zones” in the oceans, something already on the rise.

Enhanced weathering

Natural weathering of rocks removes about one billion tonnes of CO2 from the atmosphere every year — about two percent of total man-made CO2 emissions.

Spreading a powdered form of a greenish iron silicate called olivine across certain landscapes can mimic that process, experiments have shown.

DRAWBACK: It would be expensive to mine and mill enough olivine to make a difference.

Biochar

Biochar is charcoal made by heating plant waste — rice straw, peanut shells, wood scraps — over long periods in low-oxygen conditions. It can store CO2 for long periods, and also enriches soil.

DRAWBACK: The scientific jury is still out on how quickly this method could be scaled up, and on the stability of biochar used as a fertiliser.

Solar radiation management

Unlike other strategies, solar radiation management does not target CO2. The goal is simple: prevent some of the sun’s rays from hitting the planet’s surface, forcing them back up into space.

One idea is to inject or spray tiny reflective particles into the stratosphere — possibly with balloons, aircraft or through giant tubes.

Scientists have also calculated ways to alter clouds that could help beat the heat.

DRAWBACK

Even if it works as intended, solar radiation management would do nothing to reduce atmospheric CO2, which is making oceans too acidic. There is also the danger of knock-on consequences, including changes in rainfall patterns, and what scientists call “termination shock” — a sudden warming if the system were to fail.

FOREST ANIMAL POPULATIONS HAVE PLUMMETED BY HALF SINCE 1970: WWF REPORT

** Forest wildlife is vital for maintaining healthy woodlands and jungles which act as a major carbon store and help curb climate change*

AUGUST 17, 2019

A report by conservation charity WWF has found the alarming decline since the 70s has seen a huge amount of animals removed from the world's forests.

Forest wildlife is vital for maintaining healthy woodlands and jungles which act as a major carbon store and help curb climate change.

That is because creatures such as primates and large birds perform an important role in the regeneration of forests through dispersing tree seeds, eating plants and other activities – helping woodland thrive and absorb carbon.

The report is formed of a global assessment by WWF and the Zoological Society of London (ZSL), of 455 populations of 268 species.

It revealed that these forest-only groups have declined by 53 per cent on average since 1970.

The biggest threat to forest-dwelling wildlife is the loss and damage to their habitat.

Most instances of this include unsustainable logging, shifting agriculture and wildfires.

But species of mammals, amphibians, reptiles and birds are also at risk from hunting, climate change, invasive species and disease, the report said.

Declines have been greatest in the world's tropical forests, such as the Amazon.

These function as a key carbon store and habitat for nature and scientists are growing increasingly concerned that they are approaching a 'tipping point' where much could dry out and become savannah.

The report calls for efforts to halt and reverse the loss of tree cover, but warned keeping forests standing is not enough on its own to protect forest wildlife.

Other threats, such as the illegal wildlife trade and climate change, also need to be tackled, the WWF claims.

WWF is calling on world leaders to declare a planetary emergency and draw-up a new global 'deal for nature and people in 2020'.

The charity says this is needed to stop climate breakdown, restore nature and fix the food system.

Will Baldwin-Cantello, global lead on forests at WWF, said: 'Forests are complex systems that depend on the wildlife that live in them to keep them healthy and the rapid decrease in forest wildlife in recent decades is an urgent warning sign.

'Forests are home to more than half of the world's land-based animals, but they're also our greatest natural ally in the fight against climate breakdown.

‘We lose them at our peril,’ he warned.

‘We need global leaders to declare a planetary emergency and kick-start a global programme of recovery to keep our forests standing to protect our planet.’

The report pointed to success stories such as the return to forest of ranchland in Costa Rica and the increase in numbers of mountain gorillas in East Africa as ways in which the loss of nature can be reversed.

Daily Times Sunday, August 18, 2019

COLOMBIAN CITIES GATHER GREEN SPEED WITH ELECTRIC BUSES

9/21/2019 12:00:00 AM

BOGOTA: Buses belching black clouds of smoke in Colombia's streets could gradually become a thing of the past as two major cities in the South American nation launch fleets of electric buses to curb air pollution and planet-warming carbon emissions.

Cali, Colombia's third-largest city, introduced the country's first fleet of electric buses earlier this month, with 26 now circulating in the south-western city of 2.5 million people.

Another 110 battery-powered buses are slated to arrive at the end of year, according to Veronica Uribe, head of operations for Metro Cali, the city's bus system.

'For Cali, it has been important to change to a model of transport that is environmentally sustainable,' Uribe told the Thomson Reuters Foundation.

'Electric energy is a source of energy we have to take advantage of. We aim to have a public transport system that has the least impact on the environment as possible,' she said.

Funded by private bus operators and city hall, the buses can run up to 280km without having recharge.

Toxic pollution As Latin American cities struggle to stem health-harming pollution, introducing cleaner transport that also cuts emissions is a strategy that's gaining support. The plans are largely being led by policy makers in city halls and municipal governments.

With technology for electric mobility improving and becoming cheaper, more countries in Central and South America from Chile and Mexico, to Ecuador and Argentina are pushing to replace their cities' diesel-run buses with electric ones over the next few decades.

But even as more cities adopt greener transport, investment in electric buses and other low-carbon technology needs to double over the next two decades globally, according to the World Resources Institute (WRI), a US-based research group.

That is key to internationally agreed efforts to try to hold global warming to 1.5 degrees Celsius, the WRI noted.

Worldwide, cities account for about three-quarters of carbon emissions and consume more than two-thirds of energy, meaning their success or failure in reducing emissions will have a big impact on whether global warming can be kept to agreed limits.

Along with ensuring power grid upgrades and charging infrastructure is in place, finding long-term financing for cities to adopt electric bus fleets is a key challenge.

Electric buses typically cost two to three times more than diesel buses, it said.

Medellin In Colombia's second city of Medellin, city hall has financed a fleet of 64 electric buses, costing about $22 million. They will be rolled out in November, with electric taxis also taking to the streets this week.

According to Medellin's mayor, Federico Gutierrez, the bus project marks the first time a Latin American city has introduced an electric bus fleet fully funded with public money.

'More than a change of technology, this is a change of culture,' said Gutierrez, during an event to mark the arrival of the buses from China earlier this week.

'We have to look after our planet. We all have a greater awareness that we need to take care of the environment,' he said.

The electric bus fleet operating in the city of 4m people will keep more than 3,000 tonnes of carbon dioxide out of the atmosphere each year, the mayor's office said.

Each bus, which can carry up to 90 passengers, takes two hours to charge at one of 16 stations across the city. A full charge allows buses to operate for about 300km, which means they can run for a whole day without topping up.

Medellin aims 'to be the capital of electric mobility in Latin America', Gutierrez said.

The two Colombian cities, however, face tough competition from Santiago, Chile's capital, which is today Latin America's electric bus leader.

With about 200 buses, Santiago has the largest electric fleet outside of global front-runner China, according to WRI.

Colombia's capital Bogota, however, hopes to claim that top slot in Latin America as early as next year.

In June, Bogota's mayor announced a tender to buy 594 electric buses, with an aim to start operating them in 2020 in the city, which also struggles with air pollution. If successful, Bogota would boast the largest fleet of electric buses in Latin America, according to the mayor.-Reuters

CHINESE SEEK SUITABLY GRAND CEREMONY FOR 392KM ROAD OPENING

By

Our Staff Reporter

9/28/2019 12:00:00 AM

ISLAMABAD: China seeks rapid progress on a multi-billion-dollar railway line and a ‘grand inauguration’ of a 392-kilometre highway from Multan to Sukkur soon, a high level meeting has been told.

At a meeting held on Friday and presided over by Minister for Planning and Development Makhdoom Khusro Bakhtyar, progress made on projects falling under the umbrella of China-Pakistan Economic Corridor (CPEC) was reviewed and it was decided that bottlenecks in their early completion would be removed on priority basis.

The Minister told the meeting that the $8.3 billion Railway Line Project from Karachi to Peshawar (ML-1) would be taken to the CPEC Joint Coordination Committee (JCC) at its meeting due in November. He advised the price review committee on ML-1, led by the deputy chairman of Planning Commission, to expedite its deliberations in line with the directives of the Prime Minister.

The price review committee was constituted recently after the railways ministry complained to the premier that the project was facing roadblocks due to reluctance on the part of top government officials to move ahead on price negotiations out of fear of accountability in future, sources said.

In view of the unease expressed by the Chinese officials, the prime minister had directed the committee to speedily complete its working on the project and directly report to him so that responsibility for the decisions made could be shared.

Because of the huge cost estimate of more than $8.2 bn under Chinese loans, the authorities had decided to divide the project in three phases, starting with the first phase estimated to cost about $3 bn to ensure that foreign debt remained on the lower side. The proposed first phase involves four sections of 183 km, 120 km, 132 km and 118 km, with completion target of three years.

An official statement quoted the planning and development minister as saying the government wanted a new impetus to accelerate the pace of implementation of CPEC projects.

The sources said the planning and communications ministries were coordinating for a soft opening of the Sukkur-Multan Motorway next week, but the Chinese side was insisting on a ‘high-level inauguration’ because the $2.9 bn project was the largest infrastructure scheme to be completed under the CPEC so far. The sources said the Chinese embassy was coordinating with the foreign ministry for a grand inauguration ceremony for the 392 km project.

The meeting was also told that payments to the Chinese investors of power projects were smooth to the extent of 90 per cent and efforts were being made to ensure 100pc timely payments by December.

The meeting was attended by deputy chairman of the Planning Commission, Dr. Jehanzeb Khan, secretaries of various ministries and senior representatives of provincial governments.

Mr. Bakhtyar directed the relevant authorities to further improve coordination among the stakeholders in the implementation of CPEC projects to ensure sustained uplift of the country, particularly through development of social sectors.

The power secretary told the meeting that the Chinese side would present a study on demand-supply of CPEC's energy projects by October. It was decided that the study would be presented at the upcoming meeting of the Joint Working Group and would be a deliverable to the upcoming JCC meeting.

The National Electric Power Regulatory Authority apprised the meeting that it had issued the tariff for Port Qasim on Sept 16, while the law ministry would move a summary for establishing appellate tribunals to resolve tariff issues related to the energy projects.

Regarding Lahore's Orange Line project, it was informed that civil works on water and drainage facilities would be completed on time. About the Gwadar Eastbay Expressway project, it was noted that it would be on the agenda of the upcoming Ecnec meeting and the Chinese side had confirmed additional loans for it.

DROUGHT-HIT AUSTRALIAN TOWNS PREPARE FOR 'UNIMAGINABLE' WATER CRISIS

Agencies

SEPTEMBER 28, 2019

The local authorities have been trucking in fresh water, built a pipeline to a local dam and will soon start drilling in the hope of finding new supplies. For Mayor Simon Murray, the biggest worry is that Guyra is not alone.

"A lot of towns are forecast to run out at the same time – and then where do you get the water from?" he said, referring to an area that is home to some 180,000 people.

It is part of a much bigger problem in a country unused to widespread financial hardship; Australia has enjoyed growth for a generation yet livelihoods are now at risk from drought worsened by climate change, a predicament more familiar to developing countries.

Parts of northern and inland New South Wales, along with southern Queensland, have been in drought since 2016, severely depleting river and dam levels.

Australia's Bureau of Meteorology (BOM) says the drought is being driven, in part, by warmer sea-surface temperatures impacting rainfall patterns. Air temperatures have also warmed over the past century, increasing the ferocity of droughts and fires.

In New South Wales, the government has provided some local councils with estimates of an end-date to water supplies in the worst-case scenario which change along with likely demand and supply.

Dubbed "day zero" by locals, they are focusing some minds in a wealthy country where plentiful coal resources weigh against pressure for action on climate change.

"Day zero – it's a war-time phrase," sheep and cattle farmer Richard Daugherty told Reuters on his property, located near the small town of Uralla, 200 km (124 miles) inland from Australia's eastern coastline.

But links between climate change and extreme weather events have become a political football in Australia.

The conservative government has argued stronger environmental action would cripple its economy, pitting itself against its Pacific island neighbours which are particularly susceptible to warmer temperatures and rising seas.

It came under fire from British naturalist Sir David Attenborough for supporting new coal mines shortly after school children around the globe protested against government inaction on climate change and world leaders met in New York for a climate summit.

Prime Minister Scott Morrison did not attend the climate summit. He told the UN General Assembly that critics overlooked Australia's work on curbing emissions and that the country would meet its Paris emissions reduction goals.

He has also pledged A$100 million ($68 million) in extra funding to support drought-striken farmers.

Green To Brown

Guyra, population 2,000, lies in a region known as New England, where European livestock stations were established almost 200 years ago on land resembling the colonial power's green countryside.

Together with the North-West region, it produced A$2.6 billion ($1.76 billion) in agricultural production in 2017-18, according to commodity forecaster ABARES.

Murray, who also oversees the bigger regional centre of Armidale, said he first realised the scale of the problem when he noticed entire hillsides of hardy eucalyptuses dying.

Some of the region's biggest towns, which include Dubbo, with 40,000 people, Armidale, 25,000, and Tamworth, 62,000, are forecast to run out of drinking water mid-to-late next year, according to the latest government projections.

"This is going to another level – it's almost unimaginable," Murray said.

Most councils, including Armidale and Dubbo, are trying to extend the deadline by drilling into the earth to tap underground reservoirs in the hope they can access water suitable for drinking.

Even Sydney's biggest dam, Warragamba, has dropped to 50%, after almost being at capacity less than three years ago.

The central bank has warned the drought is weighing on Australia's economic growth. The value of farm production is forecast to decline by 5% to A$59 billion (£32.48 billion) in 2019–20, according to ABARES.

There is already a steep daily cost to farmers, towns and governments that are paying to truck-in water that usually drops freely from the sky.

Farmers in the Armidale area told Reuters they were now paying well in excess of A$250 ($169) to bring in 10,000 litres of drinking-quality water, which is almost double the cost of pre-drought prices.

Australia's east coast is forecast to continue sweltering for at least three more months, the country's weather bureau said.

Locals are making do. Joe George, 57, used to wash his fleet of nine school buses once a week, but now collects whatever rain falls onto his depot's rusty roof for a monthly wash to meet his contractual obligation to provide clean vehicles.

"Worst drought I've ever seen," he said at the bus depot in Guyra. "We had a bad one in the early 80s but even that was nothing like this."

IMF ASSESSES PAKISTAN'S FINANCING NEED AT $25.5B

By:

SHAHBAZ RANA

Published July 9, 2019

ISLAMABAD: The International Monetary Fund (IMF) has assessed Pakistan's gross financing requirement at $25.5 billion in this fiscal year on the back of mounting debt repayment whereas the Asian Development Bank (ADB) has indicated that it will provide $10 billion over a period of five years.

Against the need for $25.5 billion in fiscal year 2019-20, the IMF has estimated total inflows at nearly $30 billion, according to a staff-level report the global lender released on Monday. Additional borrowing of over $4 billion would be used to build the foreign currency reserves, showed the report.

The release of the IMF report coincided with the ADB's announcement of $10 billion in indicative financing from 2020 to 2024. The Manila-based lender will give $2 billion per annum, which was lower than the average $25 billion annual assistance under the present Country Operations Business Plan.

Pakistan has long been relying on external loans for financing the current account deficit and repaying the maturing debt as it has failed to enhance exports and attract other non-debt creating inflows.

The IMF noted in its report that the first year of the 39-month loan programme is "fully financed with the expected support from multilateral development banks and bilateral creditors". In this fiscal year, China will give $6.3 billion in loan, Saudi Arabia $6.2 billion, the UAE $1 billion, World Bank $1.3 billion, ADB $1.6 billion and Islamic Development Bank $1.1 billion, according to the IMF.

Pakistan will get $38 billion to meet financing needs: IMF

To support long-term debt sustainability, Pakistan has also received firm commitments from China, Saudi Arabia and the UAE to maintain their exposure throughout the programme period and to adjust financing modalities to ensure that the new financing would be consistent with the programme debt sustainability objectives, said the IMF. These countries had given short-term loans that the IMF asked Pakistan to get them rolled over.

The IMF report stated that Pakistan would need $25.5 billion this year for current account deficit financing and repayment of public and private debt. The current account deficit financing has been estimated at $6.7 billion and another $18.2 billion will be needed for repaying old loans.

The $25.5 billion estimate is similar to the level reached in the last fiscal year. Public external debt of $14.4 billion will mature this year while private sector debt maturity has been estimated at $3.7 billion. Pakistan will pay back $2.1 billion in short-term and $11.4 billion in long-term loans in this fiscal year.

However, the external inflows have been estimated at $29.9 billion including $2.3 billion of IMF lending. These inflows include $2 billion in foreign direct investment. Official disbursements have been projected at $19.9 billion.

The additional external inflows will be used to build foreign currency reserves, which have plunged below $6.8 billion. The IMF projected that the SBP's gross reserves would jump to $11.1 billion by the end of current fiscal year.

Meanwhile, the ADB on Monday began consultations to formulate a new Country Partnership Strategy (CPS), which would guide the bank's engagement in the country from 2020 to 2024, according to a statement issued by the ADB. The ADB has planned to support Pakistan with indicative lending of up to $10 billion for various development projects and programmes during the next five years, according to the statement.

The purpose of the ADB's five-year CPS (Country Partnership Strategy) is to define priorities and to support Pakistan's development goals. The new strategy will also complement efforts by other development partners. The ADB's partnership strategy will be aligned with the government's development vision and policies and is expected to introduce new approaches to development financing in urban services, energy security, transport, agriculture and water resources, education, trade and tourism, said ADB Country Director Xiaohong Yang.

IMF finally approves $6 billion package for Pakistan

She said the strategy would priorities innovation, analytical support, public-private partnership and application of new technologies. The ADB plans to provide about $2.1 billion out of $3.4 billion funds to support Pakistan's reform and development programmes during fiscal year 2019-20, she added.

The indicative $2.1 billion is $500 million higher than the IMF's estimate. In addition to public sector investments, the ADB would continue to increase its private sector operations in Pakistan to stimulate growth and revitalize exports, said the regional lender.

The new CPS will also support the road map for Pakistan's economic linkages with its neighbouring countries, particularly through the Central Asia Regional Economic Cooperation (CAREC) programme.

Source: The Express Tribune, July 9th, 2019

SOLAR – THE UNTAPPED POTENTIAL IN PAKISTAN

By

Dr. Ahmed Kiani

Jul. 08, 2019

ISLMABAD: In the last few decades, energy demand has surged as a function of industrialization, population growth, inhabitant density amplification, commercial activity intensification enhanced space mobility, de-forestation, etc.

These factors are now linked to the economic development of nations through energy economics. However, global energy scaling is hindered by international climate control treaties such as the Kyoto Protocol (Japan, 1997) and numerous United Nations Climate Change Conferences over the years (COP21, France, 2015; COP22, Morocco, 2016; COP23, Germany, 2017 and COP24, Poland, 2018).

Member states from around the world are allotted year-on-year Green House Gas (GHG) emission mitigation targets for curbing the impact of global warming. These communal gatherings for emission consensus are a result of 0.2-degree Celsius projected rise in temperature per decade globally due to emissions in the next two decades.

US company to invest in Pakistan's solar energy sector

Even so, if the concentrations of GHGs were not to change, rise in sea level and anthropogenic warming would occur for centuries.

Pakistan's current energy mix includes fossil fuels (furnace oil, natural gas and coal) and renewables (hydroelectric power, wind and solar) across its geographical vertices. The country stands at 169th place in the Environmental Performance Index (EPI) out of the 18o countries included in the study.

Although past and present governments consistently claim supply-demand parity, what still remains unanswered is the lack of rural electrification due to a low transmission/distribution network spread or grid proximity (70% of Pakistan is rural and overall grid connectivity stands at 42% to date), high cost of well-to-consumer for a multitude of reasons (dilapidated development infrastructure, shortage of investment, lack of intrinsic resources, security, etc), rising fuel import bill, under-utilisation of existing power plant capacities, shortage of fuel transport civil linkages, to name a few. All of these sources of energy generation are dirty, especially coal, and except solar.

Solar is one such clean energy resource that has made strong headway in recent years. It is by far the most popular renewable energy resource relative to its peers due to its low operational/maintenance cost, ease of installation/use and zero GHG emissions. For a country like Pakistan, solar energy is particularly suitable due to its optimal geographical location. In comparison with many European countries, most cities in Pakistan receive about 1,500-2,500 hours of sun annually, which is twice more than that of Europe.

Balochistan is particularly rich in solar energy with annual mean sunshine duration of 8-8.5 hours per day and these values are one of the highest in the world.

Unfortunately, with the technology being clean, cheap and abundant and climate platform ideal, it is a surprise that solar adoption to this day remains low in Pakistan. With several policies being passed, frameworks introduced and consultancies being sought over the last 10+ years, we as a nation have not been able to fully maximize this energy source as a value addition to the national grid.

One of the main challenges comes not from government regulations, theft or mismanagement but from the technology itself. Solar has the good fortune and a bad omen of being relatively easy to set up, compared to other renewables (such as biogas, hydro, wind, etc).

It is often commonly misconstrued as a do-it-yourself (DIY) exercise in Pakistan. Therefore, the price variation through over-customisation of solutions has rendered not only the end-user confused but also misinformed.

From street vendors in Rawalpindi to SMEs all are equally to blame for the muddle in the solar energy price control, incomplete installations, workforce misuse, misappropriation of public wealth, indecisive policymaking and unaccountable billing. The Quaid-e-Azam Solar Park is one prime example of such public-private partnership conundrum, which was hailed as a symbolic beacon of clean energy in the country.

Recommendations

From a policy standpoint, the government entities must adhere to the following recommendations for a successful renewable energy climate of the country:

GHG policies and regulation: Government should promote and implement green energy policies for resource portfolio diversification, resource availability and accessibility, infrastructure development planning, socio-economic prosperity and social welfare, geopolitical affluence and long-term sustainability of the country.

- Technology: This comes in two parts:
    1. Incentivise solar manufacturers by providing a conducive investment climate for product launch, marketing and awareness, logistical, operational, contractual, managerial and financial assistance in either a joint-venture partnership with local government / private entities or by allocating sole trader rights with long-term contracts.
    2. Incentivise consumers with green tax rebates and bonuses with net metering via upfront tariff by governmental regulatory procedures.
- Infrastructure requirements: Facilitate installation of solar technologies by creating service, operation and after-sale maintenance procedures and protocols, in a transfer-of-technology strategy collaborated with international solar companies.
- Target market segment: The network should target households rather than IPPs as is the failed approach to date. The segment of interest should be rural geographical settlements conducive to solar, as these would not only act as self-sustaining energy consumers but also energy sources forming point-

size energy generators in the overall schematic of a micro-grid. These micro-grids would eventually connect to the main national energy grid and act as actual contributors of electricity.

- Market regulators: the responsibilities of regulating bodies are restricted to electricity generation licensing, establishing standards and control for electricity generation and cooperating with regional / international consortiums for efficient supply of solar energy and upfront tariff pricing.
- Assets & communication: Ownership, responsibilities, operations and maintenance responsibilities have to be dedicated and streamlined within a framework including solar manufacturers, green government entities, management, infrastructure upkeep, power sector and transport authorities, consumer welfare departments and customer care. All communication channels should be established for efficient running of the system where all participants are monitored for a successful delivery of service.

10,800 schools to convert to solar power

Pakistan can make use of this freely available and widely distributed solar energy for improving socio-economic conditions of the people living in remote areas and for reducing the poverty level. Harnessing the sun's power is considered an attractive alternative because it is a renewable resource, causing zero pollution.

In contrast to conventional fuels, its use eliminates the need for refining, transporting and conveying fuels and power over long distances. If this potential is left untapped, we might never limit our emissions and remain fuel importers for decades to come.

The writer is a PhD in Engineering from the University of Carnbridge, United Kingdom and is an expert in emerging technologies.

Source: The Express Tribune, July 08th, 2019

CAN COMMISSION SAVE CITY FROM RUNNING DRY?

Experts warn if dropping levels are not controlled, situation will worsen by 2025

AFZAL TALIB

Lahore

SMUGGLING

25,000

kgs of betel nuts worth Rs150m were seized during a raid in Faisalabad by the Anti-Smuggling Wing, AW

Woman dies as train rams into vehicles

WHORL A 40-year-old woman died while four others were injured when a train rammed into a motorcycle and rickshaw in an under construction site near Kot Lakhpat crossing on Monday. The deceased Mukhtaran Bibi was a resident of Bank Stop and was travelling in the rickshaw when a speeding train collided with the two vehicles. Resultantly, three persons, including the rickshaw driver received injuries. They were shifted to a nearby hospital where doctors pronounced Mukhtaran dead. Chief Traffic Police Officer Malik liaquat visited the crime scene and police collected forensic evidence. A witness narrating the scene shared that the railway crossing was closed when another train was passing by. Afterwards, it was opened. When the rickshaw and bike started crossing the lines, another train all of a sudden approached. The motorcyclist left his two-wheeler on track and jumped on a side, saving his life. Meanwhile, the railway authorities suspended the driver and assistant driver and ordered an immediate inquiry, OIR CORRESPONDENT

Khawaja brothers' petitions adjourned

Lahore. A Lahore High Court (LHC) division bench adjourned hearing of bail petitions, filed by former railways minister Khawaja Saad Rafique and his brother former provincial minister Khawaja Salman Rafique, in Paragon City scam till May 29. The division bench, headed by Justice Ali Baqar Najafi, heard the post-arrest bail petitions, filed by the Khawaja brothers. At the outset of the proceedings. National Accountability Bureau's (NAB) prosecutor submitted a detailed reply and record in the court. He argued that investigation had been completed from Khawaja brothers, in response to a court query. He further argued that investigation report would be filed in the trial court within next two, three days, while a reference had been sent to the chairman for approval. However, the defence counsel argued that all allegations leveled against his clients were baseless, app



The city is on the verge of a major water crisis and the situation could hit rock bottom by 2025 if dropping levels are not controlled.

To tackle the problem, the government of Punjab has set up a water commission which is working on an emergency basis. The committee includes provincial district officers from the Water and Sanitation Agency (WASA).

According to details obtained by The Express Tribune, utilising underground water, accumulated below the ground through seepage from rivers and pounds, could be the answer. In fact, countries all over the world make great use of it. It is important to keep in mind, however, that underground water is only found in usable quantities in certain below-the-surface locations which are known as aquifers.

In the past, different governments that came into power in the province did not pay attention to the issue and made no attempts to tap into alternative sources of water before.

With the formation of the water commission, however, Lahore WASA - together with public and private housing societies and factories - have started extracting underground water and work is currently underway at parks and green belts to water those facilities.

Speaking on the matter. Managing Director of WASA Zahid Aziz told The Express Tribune that short and long-term policies are already being implemented. "In order to preserve underground water, WASA has started recycling water at parks, mosques, highways and service centers," he said.

Aziz also said that irrigation water has been stored and filtered to provide 100 cusec of water to the residents of canal colonies which will increase further in future. Moreover, the water policy aims at raising awareness among the citizens.

According to a recent survey conducted by WASA, the population of Lahore was 360,000 in 1980, but grew to 11.3 million in 2018. In the 1980s, WASA used to extract 232 million cubic meters of water whereas the private sector was extracting another 92 cubic million meters of water annually.

At present, WASA is extracting 896 million cubic meters, while the private sector is extracting 600 million cubic meters of water annually, making a total of 1,496 million cubic meters every year.

Similarly, when it comes to the installation of tube wells, WASA had 125 of them in the 1980s, but the number has now grown to 600. These tube wells extract ground water 24 hours a day and seven days a week.

Similarly, at present, the agricultural sector has 2,700 tube wells, the cantonment board's share is 68. and the cooperative housing societies have 65 of them. As for the private housing schemes, they have 110 tube wells for underground water extraction. The Walton Cantonment board has 89, while the railways department has a total of 50 tube wells used to extract underground water.

In the 1980s, the lower underground water level was 18.70 feet below the surface which grew to 77.00 feet as of 2018. Similarly, the upper level was 51.50 in 1980 which increased to 164.50 in 2018.

Although water problems were observed even 40 years ago in Lahore's Mazang area but due to unplanned urbanization, commercialization and economic activities, the water level is going dangerously low at Gulberg and Ichhra too.

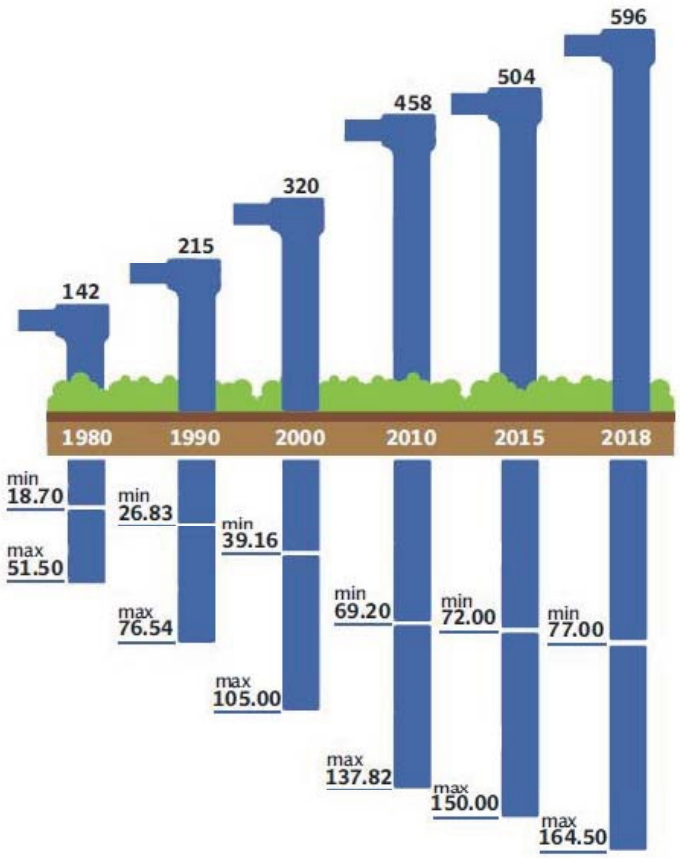
The problem is not confined to the aforementioned areas alone but other areas of the city, including Township, Green Town, Mustafabad, Samnabad, Allama Iqbal town, and Anarkali are also facing acute water shortage.

As WASA made the Punjab government aware of the crisis, the water commission was formed under the supervision of Justice (Retd) Ali Akbar.

While talking to The Express Tribune, Akbar warned that the underwater level would be dangerously low by 2025 which would deteriorate further.

"To address the issue, the Punjab government has formed the commission. Water has been recycled from mosques across Lahore and treated to provide water to parks."

Number of tubewells increased in a year



Water level below ground surface

CREATIVE-IBRAHIM YAHYA

He further said that a special force has been set up to stop people from wasting water, adding that fines will be imposed on those who will fail to comply.

"All housing societies have been restricted to stop the wastage of water. Citizens should cooperate with the government to preserve water so that the issue can be resolved in the best possible manner," Akbar concluded.

The Express Tribune of May 28, 2019

CAN COMMISSION SAVE CITY FROM RUNNING DRY?

Experts warn if dropping levels are not controlled, situation will worsen by 2025

AFZAL TALIB

Lahore

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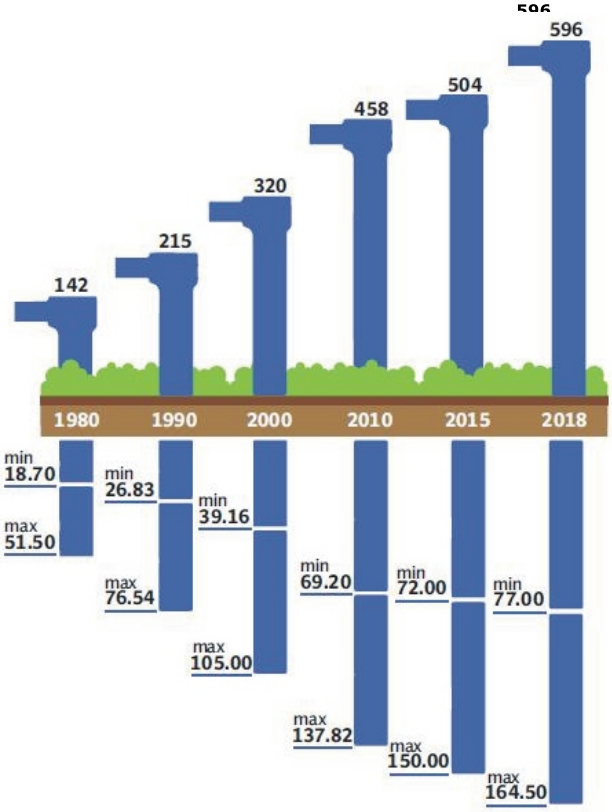
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The Express Tribune of May 28, 2019

VIENNA NAMED THE WORLD'S MOST LIVEABLE CITY FOR THE SECOND YEAR RUNNING

SEPTEMBER 8, 2019

Out of 140 Cities, Karachi is at 136th Number.



Vienna has been named as the most liveable city in the world for the second year running. The Austrian capital received near-perfect scores in a study that looked at 140 cities from around the world and scored them on stability, healthcare, culture, environment, education and infrastructure.

Melbourne is in second place, while neither London nor New York makes the top 40. The world's least liveable city was found to be the Syrian capital, Damascus, for the second year in a row.

The list has been compiled by the Economist's Intelligence Unit as part of its Global Liveability Ranking for 2019.

Sydney comes third followed by Osaka in Japan with Calgary in Canada fifth. Sixth spot is taken by Vancouver while there is a tie for seventh between Tokyo and Toronto. Only one other European city, Copenhagen in Denmark, makes it to the top ten – it's in ninth place. Adelaide sneaks into 10th place making it the third Australian city in the top ten.

The highest-ranked city in the UK is Manchester in 38th while London could only manage 48th.

The most highly-rated American city is Honolulu in 22nd. Atlanta comes 33rd, Pittsburgh 34th, Seattle 36th, Washington DC 40th, Chicago and Miami both 42nd,

Boston 45th, San Francisco 46th, Minneapolis 47th, Los Angeles 51st, Cleveland 52nd, Houston 55th and Detroit 56th. New York is ranked 58th.

The report notes that London and New York didn't fare as well as other cities as 'they struggle in the stability category, owing to perceptions of the risk of crime and terrorism'. The report also notes: 'Infrastructure is also perceived as a weakness, as both cities are struggling to cope with growing pains.'

There is a strong contingent of European cities at the top of the rankings, with eight of the top 20 cities located in the region.

Of the 68 cities awarded scores in the top tier of liveability (a rating of 80 or above), 31 are European. The only western European city not considered to be among the world's most liveable is Athens, the Greek capital.

Researchers believe this is largely owing to swingeing austerity measures and economic weakness since the global financial crisis of 2008-09, which have affected public-funded areas such as healthcare, education and infrastructure.

At the bottom of the table, cities in Africa, Asia and South America make up the least liveable cities. These are Caracas (131), Algiers (132), Douala (133), Harare (134), Port Moresby (135), Karachi (136), Tripoli (137), Dhaka (138) and Lagos (139). Meanwhile, for the first time, the index also notes the impact of the effects of climate change on liveability.

Several cities, such as New Delhi and Cairo, received big downgrades on their scores owing to problems such as poor air quality, undesirable average temperatures and inadequate water provision.

Meanwhile the report also highlights the cities that have had the biggest climb up the index over the past five years.

These are Moscow, Belgrade, Hanoi, Kyiv and Abidjan – a city in Côte d'Ivoire.

Cities that have dropped down the index the most in the past five years are Detroit, Asunción in Paraguay, Tunis, Caracas and the Libyan capital, Tripoli.

Agathe Demarais, the EIU's global forecasting director, said: 'Western Europe and North America continue to be the most liveable regions in the world, and cities in these regions remain well placed in the overall rankings. Western Europe is home to the top-scoring city, Vienna, hosts 16 of the top 30 and 26 of the 68 that record scores of 80 or higher. 'In general, cities in northern Europe score highly, while those in southern Europe achieve poorer scores by comparison, hampered by factors such as higher crime rates and slightly weaker infrastructure scores.

'The regional average ratings for western Europe and North America both exceed 90, which is significantly higher than the next-best regional average – 73 for Asia and Australasia.

'In western Europe, the category with the highest average score is healthcare, universal free healthcare coverage. In previous editions, Europe was subject to higher perceptions of the risk of terrorism, which has pulled down both local and regional averages. Over the past year, however, there have been perceived improvements in security and stability in western European cities.

‘Central and Eastern European cities tend to group together in the index, with many occupying the second tier of liveability, where day-to-day living is generally adequate and stable, but some aspects of life may be more challenging.

‘Cities in former Soviet republics have tended to score well on education, a legacy effect from the communist era. However, this is offset by another lingering feature of the Soviet period, underinvestment in infrastructure. That said, the past five years have seen solid improvements in this category in many cities, particularly those benefiting from EU investment.

‘We expect problems relating to climate change to put increasing pressure on liveability scores in the coming years and for the number of cities affected to grow. “In recent years liveability has generally been rising, thanks to improvements in stability and better education and healthcare provision in cities within emerging markets, but these improvements are under serious threat from an increasingly adverse climate.”

ISLAMABAD: THE GOVERNMENT CONFIRMED ON SUNDAY SUCCESSFUL COMMERCIAL OPERATIONS OF A $2 BILLION 1,320MW COAL-FIRED POWER PLANT SET UP BY THE CHINA POWER HUB GENERATION COMPANY (CPHGC) UNDER THE CHINA-PAKISTAN ECONOMIC CORRIDOR (CPEC) PROJECT

“M/s CPHGC has successfully undergone through commissioning tests as per the agreed procedure. The engineer has certified the successful commissioning of the complex,” said a notification issued by the Central Power Purchasing Agency (CPPA) — a government-owned subsidiary responsible for procuring power from plants and selling them to distribution companies.

The CPPA said the power producer had called for declaring its commercial operation date (COD) from Aug 17, 2019, while its engineer — SGS — had also issued certificate of initial tested capacity that came out at 1,249MW. Therefore, it called upon the National Power Control Centre (NPCC) to issue dispatch instructions to the CPHGC keeping in view the system requirements.

Separately, the CPHGC announced that it had successfully declared the COD of its 1,320MW (2x660) imported coal power plant and integrated jetty with coal transhipment capacity of 4.2 million tonnes per annum.

The CPHGC is a joint venture between the Hub Power Company (Hubco) and China Power International Holding (CPIH) and a part of early harvest energy projects under the CPEC framework agreement.

The government had approved the processing of 1,320MW imported coal-based power project at Hub in November 2014 and the joint venture of Hubco and CPIH was issued letter of intent in June 2015. The National Electric Power Regulatory Authority (Nepra) had approved the upfront tariff for the power project in February 2016. The Joint Cooperation Committee (JCC) of the CPEC included a 660MW unit of the project in the list of ‘priority projects’ and the remaining 660MW in ‘actively promoted projects’ under CPEC framework agreement of Nov 8, 2014.

As the questions about ‘capacity trap’ started arising, the government had decided in 2016 to give up one of the two 660MW plants to contain reliance on imported fuels and reduce foreign exchange losses. However, it was compelled to restore the full capacity after the Chinese partner of the joint venture took up the matter at the highest level and then followed it up at the 6th JCC meeting in December 2016.

The Pakistan government was told that commercial viability of the Hub power project on supercritical technology was possible only with 1,320MW for which it had also been given tariff by Nepra at the request of Islamabad. It also took the stance that negotiations and processing of the project starting in November 2014 pertained to 1,320MW for which financial arrangements had also been ensured and its unilateral reduction to 660MW at an advanced stage was unacceptable.

On Sunday, the company said it had developed the plant in a record time, as per schedule and within the projected cost, and would add nine billion units (kWh) of electricity to the national grid every year, meeting the electricity needs of four million households in the country.

The project's two units achieved synchronisation with the national grid on Dec 28, 2018 and May 28, 2019, respectively, while the Integrated Coal Jetty became operational in December last year with the arrival of the first shipment of coal.

"The successful completion of CPHGC project has fortified the dream of energy independence of Pakistan," said Khalid Mansoor, the Chief Executive Officer of Hubco, adding that "Pak-China synergy has resulted in engineering excellence and has fulfilled our promise of providing Pakistan with affordable and ample energy".

He said the project had on Aug 14 completed a reliability run test involving a weeklong uninterrupted power supply at different loads that formally completed the commercial operation date certified by independent engineers as required under the power purchase agreement. This was followed by net electrical output confirmation by engineers in the presence of representatives of the National Transmission & Despatch Company.

The company said the project had also delivered on various social commitments for improving the lives of the local community of Hub and Lasbella. Together with its partners, the CPHGC has set up a school in Gadani, a floating jetty for fishermen in Abbas village and conducted various training and development programmes for the youth of Balochistan.

The Pakistani principal of the project — Hubco — currently produces over 2,920MW through its four plants spread over Balochistan, Punjab and Azad Kashmir. Hubco is the only power producer in Pakistan with four projects listed in the CPEC, out of which three are under construction — Thar Energy Limited, Thalnova Power Thar (Pvt) Ltd and Sindh Engro Coal Mining Company — at Thar Block II. The power generation capacity of the company has increased to over 3,580MW after the completion of the latest project.

Published in Dawn, August 19th, 2019

COMMENTARY / INSIGHT

WATER: A POTENTIAL CASUS BELLI

Muhammad Nawaz Khan

SEPTEMBER 8, 2019

Despite having water agreements with India, the Himalayan states of Nepal and Bhutan, unfortunately, receive an unequal share of their mountainous water resources.

Water-sharing is a complex problem. It needs a logical solution for its equitable distribution. However, it is often difficult for the most amiable border nations to reach a unanimously agreed water-sharing formula for regulating their transboundary water reserves. South Asian countries have signed various water treaties to resolve their water disputes. Yet, in most cases under these treaties, the dispute resolution mechanisms are either not fully evolved, like Ganges Water Treaty, or demand full implementation of all the clauses of the treaties in true letter and spirit, like the Indus Water Treaty (IWT).

Water in South Asia is a source of both conflict and cooperation. One example of cooperation in the region is the IWT 1960 signed between Pakistan and India, which shows riparian cooperation. The treaty has survived two major wars. Since water is a politically charged and emotive issue, it is subject to various interpretations and disputes.

In this regard, there is a conflict over the shared water resources between Pakistan and India such as the former claims that the latter manipulated the treaty in its favour.

Islamabad has shown its concerns that Delhi has moved far away from its obligation and has been twisting the clauses and violating the IWT, which hampers its implementation. India's large-scale diversions by constructing dams in violation of the IWT have far-reaching consequences for socio-economic growth and national politics regarding water distribution within the provinces in Pakistan.

Another case from South Asia is the co-operative water agreement between Bangladesh and India, in which the former has been in constant strife with the latter to receive its agreed share. Although the Ganges Water Treaty, signed in 1996, was initially considered major progress by the political regimes of both countries, the treaty failed to address or resolve all bilateral disputes of the Ganges' waters.

The treaty is considered "imperfect" by the political realists in Bangladesh. Dhaka has been protesting against the violation of GWT by India. Various allegations and suspicions continue to fuel criticism of the treaty by the Bangladesh Nationalist Party and have created tensions in their bilateral relationship. The nature of water conflict between Bangladesh and India is of high conflict and low cooperation dynamic because unlike the IWT, there is no dispute resolution mechanism.

Unlike Bangladesh, the nature of water conflict between India and Nepal is of high conflict and high cooperation – given exploitation and interference by India for obtaining Nepal's water resources – which has led to strong disagreement over the precise definition of the clauses of their co-operative water treaty. For instance, the age-old disagreement persists in India and Nepal over the interpretation of the Sugauli Treaty signed in 1816 between Nepal and British East India Company, which delineated the frontier along the River Maha Kali in Nepal.

Islamabad has shown its concerns that Delhi has moved far away from its obligation and has been twisting the clauses and violating the IWT, which hampers its implementation

In 1997, when Nepal planned to work out a treaty on hydroelectric development of the river, the Indo-Nepal rift deepened when both failed to decide which stream constituted the source of the river. Nepal considers the Limpiyadhura as the source stream, while India claims Lipu Lekh to be the source stream. Nepal wants to utilise its water resources for generating electricity, which is not only necessary to meet its energy demand, but also to generate revenue while exporting energy to other South Asian countries. However, its wish to export electricity and develop hydro projects is also tied to India's will, due to its border blockade by India.

On the contrary, the water dynamic between India and Bhutan is one of the low conflicts and low cooperation. Resultantly, both countries have little interaction between them over shared water resources. Although Bhutan has the highest per capita annual water availability in South Asia, the country is facing the internal challenge of water accessibility. Households across the country face drinking water issues. Bhutan also needs water storage capacity, which is subject to its lower riparian, i.e. India's will.

In this context, despite having water agreements with India, the Himalayan states of Nepal and Bhutan, unfortunately, receive an unequal share of their mountainous water resources. India, a low riparian state, uses upper riparian privileges while influencing and dictating the water projects of these two landlocked mountainous states. Thus, the water issues between the co-riparian countries of the region remain 'a potential casus belli.'

In a nutshell, the existing channels of dialogue, bilateral agreements and dispute resolution mechanisms, require that the South Asian countries display firm commitment in fulfilling the requirements of existing water agreements; cooperate with its riparian states on water; maintain an ecological and biodiversity balance; discard unilateral actions on run-of-the-rivers and restrict itself in constructing massive hydro projects/dams. Only then, the possibility of water conflict turning into a full-fledged war could be avoided. If they do not act accordingly and continuously violates the sensitivity of South Asian water cooperative regimes, water could likely become a threat to regional security.

The writer is a research officer at the Islamabad Policy Research Institute

CANADIAN ICEBERG HUNTER IN SEARCH OF ‘WHITE GOLD’



BONAVISTA: It’s midday and Edward Kean, a Canadian fisherman who now scours the North Atlantic for icebergs that have broken off from Greenland’s glaciers, is beaming. Using his trusty binoculars, the rotund, 60-year-old captain of the fishing boat ‘Green Waters’ has spotted his next prize — it’s several dozen metres tall and floating just off the coast of Newfoundland.

“It’s a very fine piece of ice,” he proclaims.

Every morning at dawn, Kean sails out with three other crew members to hunt what has become his own personal white gold: icebergs.

For more than 20 years, he has hauled in the mighty ice giants and then sold the water for a handsome profit to local companies, which then bottle it, mix it into booze or use it to make cosmetics.

Business has soared in tandem with the warming of the planet, especially in the Arctic, meaning that more and more icebergs find their way south.

But it’s a tough gig. The days are long and the “harvest” isn’t easy.

For this particular prize, which he first picked up using a satellite map, Kean has to sail about 24 kilometres.

To kill time, the crew members swap jokes in the colourful local dialect — English with a Scottish and Irish lilt.

“Even I struggle to understand them sometimes,” laughs the captain, who lives in St John’s, the capital of the eastern province of Newfoundland and Labrador.

Arriving at the foot of the massive wall of floating ice in Bonavista Bay, which opens into the Atlantic, he shoulders a rifle and blasts away in the hopes that some of it will break off.

One, two, three shots ring out. The air shudders with the noise and the crew hold their breath. But the ice does not split. “Sometimes it works, sometimes it doesn’t,” said Kean.

Race against the clock

As summer gets under way, time is of the essence in harvesting the icebergs. “They come here and they melt so fast,” noted the captain, adding that once they are floating off the coast of Newfoundland, it is a real race against the clock.

“In Newfoundland, it’s like a fallen leaf. They’re going to die in a couple of weeks and be gone back to nature anyway,” he said.

“So we’re not here hurting the environment, we’re not taking nothing away — we’re just utilising the purest water we can get.”

Two members of his crew set out on a motorboat, circling the iceberg, even brushing against it, to find blocks of ice that may be bobbing next to it.

Armed with a pole and net, they laboriously wrap up the precious fragments, each one weighing a ton or two, and fasten them to a hook at the end of a crane on the fishing boat’s deck, which winches them aboard.

Kean then hacks the blocks up with an axe and puts the pieces into 1,000-litre containers to melt over the coming days.

In the high season, from May to July, the crew can gather 800,000 litres of water, which they sell to local merchants for a dollar per litre.

Those businesses in turn market the iceberg products as made from some of the purest water money can buy.

Dyna Pro, one of Kean’s clients, sells the water in glass bottles for $12 each. They are targeting a wealthy clientele and have hopes to expand their business abroad.

“We’re probably a lot bigger today than we ever were with iceberg water shipping overseas — Europe, Singapore, Dubai,” said the company’s manager, Kerry Chaulk.

“We just picked up clients from the Middle East with our glass bottles.”

The popular Auk Island Winery, in the tourist village of Twillingate, makes wine from wild berries and iceberg water — and sells it for Can $10-90 a bottle.

“We use iceberg water because it is the clearest, cleanest water that we have available on the planet, really,” says employee Elizabeth Gleason.

“It will give you a very clean, very pure taste of whatever it is paired with.”

US tourist Melissa Axtman, who has family roots in Newfoundland, said she was “enjoying all the things made out of iceberg water”. But she acknowledged “good things and bad things” about the increasing number of icebergs, a symptom of climate change.

Experts say the Arctic is warming three times faster than the rest of the planet.

Despite the success of the products, the crew of the Green Waters remains small and the tools they use for the harvest have barely changed in decades.

“Nobody wants to manually work at this type of work anymore,” said Kean, who has trouble keeping crew members for long.

Published in Dawn, August 4th, 2019

SINKING CITY: INDONESIA'S CAPITALS ON BRINK OF DISASTER



JAKARTA: Barriers are being plugged in to protect houses from sea waves.—AFP

President Joko Widodo says the new capital will be moved to Borneo

JAKARTA: Time is running out for Jakarta. One of the fastest-sinking cities on earth, environmental experts warn that one third of it could be submerged by 2050 if current rates continue.

Decades of uncontrolled and excessive depletion of groundwater reserves, rising sea-levels, and increasingly volatile weather patterns mean swathes of it have already started to disappear.

Existing environmental measures have had little impact, so authorities are taking drastic action: the nation will have a new capital.

Its location could be announced imminently, according to local reports.

"The capital of our country will move to the island of Borneo," Indonesian leader Joko Widodo said on Twitter.

Relocating the country's administrative and political heart may be an act of national preservation, but it effectively sounds the death-knell for Jakarta where many of the city’s 10 million residents have little means of escape. "When, the floods came I used to tremble." food stall owner Rasdi said.

"I nearly drowned back in 2007 — all my belongings were swept away and I had to start over again," said from his home close to Jakarta's northern port, one of the worst affected by sinking ground.

Built in an earthquake zone, on swamplands, near the confluence of 13 rivers, the city's foundations have been further stressed by unchecked development, heavy traffic, and poor ' urban planning.

Jakarta doesn't have a piped water system in its northern reaches, so local industry and millions of residents tap into its aquifers.

This rampant groundwater extraction causes land subsidence, which is making Jakarta sink by as much as 25 centimetres (10 inches) a year in some areas — double the global average for major coastal cities.

Today some parts of it sit some four metres below sea level, irrevocably changing the landscape, and leaving millions vulnerable to natural disasters.

Flooding is common during the tropical nation's wet season and that is expected get worse as sea levels rise due to global warming.

The partly submerged skeleton of an abandoned mosque at the waterfront underscores the severity of the problem, while vast puddles scar the roads, and for some the ground floor of their homes is no longer habitable.

Murky green water flows along the floor of an abandoned building, while tiny shacks on stilts line the garbage-strewn waterfront.

"You can see it with your own eyes," said Andri, a 42-year-old who liked many Indonesians goes by one name.

"When I was a kid I used to swim over there," he added, motioning off in the distance.

"Over time the water just kept getting higher and higher." Even as Widodo presses on with the plan for a 21st century capital in Borneo island, local authorities are desperately probing solutions for Jakarta.

A scheme to construct artificial islands in Jakarta's bay, which would act as a buffer against the Java Sea, as well as a vast coastal wall was approved.

But there is no guarantee the estimated $40 billion project — which has been beset by years of delays — would solve the city's sinking woes.

Building barriers has been tried before. A concrete wall was built along the shore in Rasdi's district and other high-risk neighbourhoods.

But they have cracked and show signs of sinking already. Water seeps through them, soaking the maze of narrow streets and shacks in the city's poorest neighbourhoods.

Cities at risk

"Building walls is not a permanent solution," said Heri Andreas, an earth scientist at the Bandung Institute of Technology.

"We need to go to the next step and fix our water management." The hub of Southeast Asia's biggest economy has seen breakneck development over the years. New buildings and skyscrapers are compressing the ground, which aggravates its sinking problem.

But the biggest culprit is excessive groundwater extraction, and the city has no way to meet demand without it due to a lack of water-retention facilities or a comprehensive piping network, Andreas said. Jakarta is not the only sinking urban centre.

Cities from Venice and Shanghai to New Orleans and Bangkok are also at risk, but Jakarta has done little to tackle the problem head on, according to Andreas.

"They've taken steps to mitigate it," he said of other sinking cities.

"It's expensive. But if we look at the future consequences, it'll be worth it.

"The thing we always have problems with is where to start," he added,

Many who earn their livelihood in Jakarta's most dangerous neighbourhoods don't have the luxury of time to wait for a solution — or the means to escape.

"Of course I'm worried, but there's nothing I can do," said Rastini, who scrapes by de-shelling clams caught by local fishermen.

The 40-year-old added: "I've been here since I was a kid and I'll stay here."—AFP

Buildings and Cities

BRITISH ARCHITECT URGES PAKISTAN TO GET BACK TO ITS BASICS

By

Our Staff Reporter

LAHORE: Pakistan needs to get back to its architectural basics if it wants to keep its buildings and cities livable and environment sustainable, says Jason Pomeroy, an internationally acclaimed thought-leader on sustainable architecture.

British born and educated Jason, who has designed some energy efficient marvels around the world, is currently in Pakistan -overseeing one of his projects and collaborating with academia for study courses for sustainable city designs.

Speaking to Dawn, Jason drew upon the history of local architecture, saying it was environment and human friendly for many millennia: the Indus Valley Civilization architecture respected environment and all trappings and so did the British buildings. The situation took a curve with globalization: the Chicago (read American) skyscrapers made of steel, cement and glass became symbols of state and individual affluence and influence.

The Gulf region quickly followed the trend for its (petro-dollar) development turned into a jungle of concrete, glass and steel. The rest of world followed soon. These energy-guzzling structures challenged environment like never before in human history.

In addition to energy disaster, they also made cities chokingly congested, water supplies difficult and traffic regulation almost impossible. These civic troubles assumed global proportion as globalization of the particular kind of architecture took hold of the most of the world, Jason explained.

"However, fortunately this diagnosis is also a prescription: get back to the basics - use the natural endowments to keep buildings cool. Pakistan, with ambitious five million homes plan in next five years can make it a starting point to revert to its indigenous art of architectural design - using the sun direction to avoid heat and wind as heat carrier to keep its homes cool instead of mechanical air-conditioning and ventilation.

"As a second measure, it should also ensure that every household generates (using renewable resources like wind and solar) as much clean energy as it uses, taking pressure off the national grid that largely depends upon pollutant thermal or coal generation."

Explaining his idea of environment-friendly housing, Jason said: "Ideally, it has to be zero energy consumption building design and we have created such buildings in different parts of the world. But if it needs some amount of energy, the consumption should be kept to the minimum and generated locally. That is what we mean by sustainable housing projects and cities."

Expanding the same sustain ability concept from homes and commercial buildings to city designs, Jason categorizes them in three heads: smart cities, second and third generation smart cities. First sort of cities, he thinks, are those where government leads (invest in) development effort and uses technology. Second generation is where city planning revolves around people: cities are planned to meet people's demands of spaces, clean air and clean water. Third category revolves around official investment, rules and regulations written to ensure clean environment and cities designed around the people, instead of vehicular traffic.

Pinning hope on the younger generation, Jason thinks that youth, better educated and informed on all environmental issues, is expected to lead the campaign for such housing and city planning. "They know the problem, its causes and cost. So, they would force private and public sector to respond to the problem and cleanse the environment," Jason concluded.

VIRTUAL PIPELINES CAN BE USED FOR GAS TRANSPORTATION

By

Syed Akhtar Ali

Jul. 15, 2019

ISLAMABAD: Oil whether crude or finished products has been transported with ease in normal bowsers and trucks. This has not been the case with natural gas as it is too light.

Gas pipelines have been used for transporting gas. Often there are far-off areas with lesser demand to which expansion of gas network may not be economical. Also, there are small gas resources in far-off areas including biogas which are not transportable through the gas network.

There are non-pipeline methods of gas transportation, now being widely used in many countries. There is a potential to introduce the same in Pakistan, which is the subject of discussion in this space. Liquefied natural gas (LNG) and compressed natural gas (CNG) have high energy densities, which are 600 and 200 times respectively of the ordinary natural gas at normal temperature and pressure, and thus are good candidates for road and rail transportation through trucks and wagons.

OGRA recommends 47% hike in gas tariff

LNG trailers

LNG is a chilled gas (at minus 160 degree Celsius) and requires heavily insulated tanks/tubes that are mounted on trailers. Fortunately, highly efficient and effective material and methods are now available, which make this possible without causing energy loss or creating insurmountable safety issues.

LNG can be transferred directly in liquid form without regasification to LNG bowsers and transported to points of consumption. Regasification facilities, however, have to be installed at the user end. This requires space and capital, which is not normally excessive.

CNG stations in many countries have installed such facilities and have become independent of the gas utility or CNG stations have been set up in far-off places where the gas network is not available. There are heavy-duty trailers, which run directly on LNG, for which LNG-CNG stations have built underground insulated LNG tanks and have installed LNG dispensers for the LNG-fuelled trailers.

There are proposals in Pakistan by private parties to introduce this system for CNG and industrial users. Expensive LPG currently being used in LPG-air mix plants can also be substituted by LNG.

Conversely, some gas resources and fields are too small and thus remained stranded. In oil fields, there is associated gas which is flared into the atmosphere, causing environmental damage and resource loss. Such gas resources are liquefied

through mobile skid-mounted or even stationary liquefaction plants and the chilled gas is transported to end-users directly or supplied to the gas utility.

CNG transportation

CNG transportation through trucks has been in vogue for a longer period than LNG transportation. CNG cylinders of the same size as are installed in CNG stations or even large ones are interconnected and a booster is installed as well. There are even longer tubes of truck length that are utilised.

The limitation is on diameter and not on length. CNG is filled in cylinders at some suitable station (called mother stations) and transported to CNG stations (called daughter stations), which do not have gas supply. Such CNG trucks themselves are used as mobile CNG stations in which dispensers are also installed.

CNG can also be transported to areas where gas supply is not available. Local grids are connected directly to these CNG trailers and gas is released as per requirement.

CNG has been under controversy as CNG station owners have been perceived to be big stealers of gas. It may or may not be true. Gas stealing by CNG stations and other large commercial consumers can be controlled through mother-daughter concept, although there are other ways to control the same. In Pakistan, such mother-daughter system has not been installed yet. This system can bring in a wholesale CNG supply business. Commercial land cost in busy areas is high. Daughter stations not requiring compression facilities need much less space. Mother stations can be set up in cheaper land areas and possibly connected with high pressure pipelines, thus providing a cheaper solution.

However, transportation cost is an addition, which will determine the suitability of this system. In India, this system is very popular.

Direct filling stations

Public transport or large fleet operators can benefit from this system. High pressure stations called SMS in our terminology have high pressure gas at 1,000-1,500 psi. CNG is at 3,000 psi. A compressor with a doubling or tripling ratio can be installed at such stations and CNG can be filled with very economical electricity consumption and thus lower cost.

Normal CNG compression requires 20 times compression and this only 2 or 3 times compression. It should result in proportionally lesser electricity consumption. Large urban areas in the country like Karachi, Lahore, Rawalpindi, Multan, Peshawar, etc can benefit from such a system; needless to say that a high political dividend can be reaped through the installation of such systems.

Biogas and bio-CNG

Pakistan is an agricultural country producing abundant bio-waste. Also, it is the fifth largest milk producer with proportional ranking in the population of milk animals, which produce dung – an ideal ready material for bio-gas.

In Pakistan, programmes for small family-size biogas plants have been promoted, which should continue. However, much waste material still goes unutilised or under-utilised. Commercial-scale biogas can be produced in far-off agricultural areas. Local grids can be installed where feasible.

Local bio-CNG stations can be installed. Also bio-CNG stations can be set up in mother-daughter mode, should the production scale justifies it.

Commercial biogas production is common in many countries of Europe and is even pumped into the standard gas grid after necessary processing. There is a target in Europe to supply 20% of gas requirements through biogas. In India, bio-CNG has become popular and is cheaper than normal CNG.

Biogas and bio-CNG have become generally competitive in the wake of high LNG prices. Landhi Cattle Colony in Karachi appears to be an ideal location for installing mother CNG supply stations.

No oil, gas reserves found off Pakistan shore

Flared gas use

Oil fields produce associated gas which sometimes is not in industrial quantities and is normally flared. There may be opportunities to utilise this waste. There is a flared gas utilisation policy issued lately in 2016. In certain situations, where no commercial use or user is found, the flared gas can be diverted and put at the disposal of the government free of cost.

Flared gas can be used in direct burning, possibly without much processing, if it is not required to be pumped into the gas grid. Industrial boilers and possibly home cookers can use this gas. Above virtual pipeline methods can be used in this case.

CNG can be made more competitive through methods discussed above. With the new gas tariff and rupee depreciation, economics has become topsy-turvy. One has to wait until things stabilise to make final judgment in this respect.

Source: The Express Tribune, July 15th, 2019.

WITH PLASTIC STRAW BAN, WASHINGTON TURNS ITS BACK ON ITS OWN INVENTION

"How do you drink a milkshake without a straw?"

It is a question the city of Washington will soon face after deciding, in the interest of the environment, to ban plastic drinking straws -- an almost sacrilegious act in the birthplace of this simple object, a seemingly indispensable part of daily American life.

Washington: In the last century, millions of straws were produced in the Stone Straw Building, a stolid-looking structure of yellowing brick in a residential neighborhood. The building now houses the capital's transit police headquarters.

The only visible sign of its historic character comes from a discreet commemorative plaque affixed to a wall above a garbage bin that honors the memory of Marvin C. Stone, "Inventor of the Paper Straw."

According to legend, Stone, who settled in Washington after being wounded while fighting for the Union side in the Civil War, had the inspiration one evening while sipping on his favorite cocktail, a mint julep.

At that time, people sometimes used actual straws — dried lengths of ryegrass — for drinking, but Stone was put off by the inescapable rye-flavored residue they imparted.

So he adapted a machine already in use for making paper cigarette holders, instead wrapping spirals of paper around a pencil-like cylinder, attaching the ends with wax and then removing the cylinder.

He filed for a patent in 1888 — the objective, he said in his application, was to create a "cheap, durable and unobjectionable substitute for natural straws commonly used for the administration of medicines, beverages, &c." — and the rest is history.

But almost a century and a half later, his ungrateful adoptive home became the second large US city, after Seattle, to ban the plastic descendants of Stone's popular invention.

The ban technically took effect January 1 but it came with a grace period, meant to ease the transition for restaurants and businesses, that ends July 1.

Everything 'to go'

"A lot of businesses are still using plastic straws and don't have a strategy," said Kirk Francis, who manages the Tastemakers food hall in a former mayonnaise factory adjoining the Stone Straw Building.

The young, environmentally minded entrepreneur faced the same existential question years ago when he launched "Captain Cookie and the Milk Man," a food truck selling baked treats and dairy products: "How do you drink a milkshake without a straw?"

He considered straws of metal, of biodegradable paper or of vegetable-based material — many of them more expensive or flimsier than those of plastic — and says he has yet to find a "good solution."

The youthful "Captain" Kirk, who wears a Cookie Monster cap over his curly brown hair, knows that most of his customers don't really care that much: "Customers want a straw that works well."

So getting people to give up their straws will not be easy. They have been an inextricable part of American culture since they were first promoted as a way to curb the spread of disease at a time when people would share a common cup when drinking from public fountains.

Another American, Joseph Friedman, elaborated on Stone's invention in the 1930s after watching his daughter struggle with a milkshake. His modification, the flexible straw, has grown in popularity alongside other mainstays of Americans' consumer culture: soda fountains, carry-out food, iced drinks with lots of ice.

Plastic on plastic

The ban on plastic straws is really just a symbolic beginning, said Sarah Perrin, a Tastemakers customer, who was with her young daughter. Five-year-old Lily was using a plastic straw to sip fruit juice from a plastic cup topped with a plastic lid.

"Without a straw, she would spill it all over," her mother said.

"The straw ban comes from a good intention, but what about disabled people and kids?" Perrin asked. "It can help us feeling better about ourselves, but does it really make a difference for the environment if we don't target the corporations first?"

Collin Odell, sitting with his dog on the food hall's terrace — with a view of Marvin Stone's old factory — was also using a plastic straw as he drank a guava juice beverage with plenty of ice.

"It came with my order!" the young resident of Brookland, a fast gentrifying neighborhood, explained a bit defensively.

"I'm fully on board with the ban, if it can help reduce the massive amount of garbage in the oceans," he said.

Odell said he is seeing fewer plastic straws in Washington.

"But it's not the case elsewhere in the country.

"I'm always amazed when I travel outside of DC to be served in Styrofoam cups" — yet another very American obsession.

Source: Daily Times Sunday, June 30, 2019

NASA IMAGES SHOW SMALL ISLAND OFF GWADAR COAST HAS 'DISAPPEARED'

By

Faiza Ilyas

7/13/2019 12:00:00 AM

KARACHI: A small mud island that emerged off the coast of Gwadar in 2013 following a massive earthquake hitting parts of Balochistan and Sindh has disappeared, images released by the US National Aeronautics and Space Administration (Nasa) show.

Zalzala Koh, the oval-shaped island which was 20-metres high, 90-metres wide and 40-metres long, was the product of a mud volcano triggered by a massive earthquake measuring 7.7 on the Richter scale.

I' have been following this island since 2013 and honestly, I did not expect that it would last that long. There could be multiple reasons for that. For example, the triggering force that threw the pile of sediments in 2013 has somehow 1 (ept the underwater mass in a reasonable state,' said Dr Asif Inam, a former director general of the National Institute of Oceanography (NIO).

According to Dr Inam, who heads the Bahria University's maritime sciences department, said 'It's very likely that we see more islands in the vicinity in the time to come as islands produced by mud volcanoes have a history of coming and going in this region.

In this respect, he referred to the devastating Makran earthquake in 1945 which completely destroyed the coastal towns in Pasni and Ormara and led to the emergence of four islands.

'This has been documented indetail by Dr V.P. Sondhi in the Geological Survey of India (published in 1947) and it's surprising to note how similar in features those islands were to this one, said Dr Inam.

Experts said that it's the third time in 15 years that such a phenomenon had occurred along the Balochistan coast. Earlier, islands emerged in 1999 and in 2011 at a distance of two kilometres from the Makran coast near the point where the Hingol River drains into the sea.

Both islands emerged without an earthquake and collapsed due to strong currents and winds.

According to scientists, the Makran coastal belt is reported to have extensive reserves of frozen methane that exist in the form of gas hydrates (crystalline water-based solids physically resembling ice, formed under conditions of relatively high pressures and low temperatures) hundreds of metres below the sea floor. And whenever this highly pressurized gas finds a weak space to release some of its energy, a dome-like structure (island) is created within the waters or it emerges on the sea surface.

‘It’s an active seismic region where three tectonic plates Indian, Eurasian and Arabian are converging. The space to release energy could be formed due to tectonic movements, creating some fractures and fissures in the strata.

‘Sometimes, the structures do not come out of the water and so go unnoticed and could prove to be a major hazard for sea traffic,’ Dr Inam explained.

He underscored the need for regular monitoring and mapping of the area in detail to ascertain the potentially hazardous parts (unnoticed structures) as well as to explore the possibility to overcome the energy crisis.

The analysis of previously tested gas samples showed that it contained methane, ethane, propane and butane. The experts said that research activities in the particular area had been carried out in the recent past by the NIO and Pakistan Navy in collaboration with Chinese research institutions, but there was a need to do a lot more.



AN image of the island taken in September 2013 – Coutesy Live Science

LOOMING 'CLIMATE APARTHEID' COULD SPLIT THE WORLD INTO THE RICH AND THE DEAD, UN WARNS

By

Brandon Specktor, Senior Writer

MORE



Commuters wade through a waterlogged street after heavy rainfall in Guwahati, Assam, India in June, 2019. According to a new UN report, more than 100 million people living in South Asia, Sub-Saharan Africa and Latin America face a direct threat to their health and human rights at the hands of climate change.

Through droughts, floods, fires and famine, the escalating effects of climate change will touch every single life on Earth in the coming decades, though hardly with equal force. According to a new report from the United Nations Human Rights Council (HRC), the world's poor could be hit so powerfully by the hardships of climate change that the very concept of human rights might break with them.

"Even under the best-case scenario [of reduced carbon emissions], hundreds of millions will face food insecurity, forced migration, disease, and death," Philip Alston, a U.N. human rights and poverty specialist, wrote in the report. "While people in poverty are responsible for just a fraction of global emissions, they will bear the brunt of climate change, and have the least capacity to protect themselves."

Indeed, Alston added, the world may be barreling toward a "climate apartheid," where the wealthy pay to escape the fire and famine of climate change while the rest of the world is left to suffer.

In the new report, published yesterday (June 25) by the HRC, Alston synthesized the findings of more than 100 prior reports and scientific studies to show that climate

change poses a direct threat to the basics of food, water, health and housing for hundreds of millions of people around the world, but especially those living in sub-Saharan Africa, South Asia and Latin America. Developing countries will bear an estimated 75% of the costs of climate change, the report noted, despite the poorest half of the global population contributing just 10% of global carbon emissions.

Governments, corporations and even human rights organizations (including the U.N.) have been aware of these climate-related threats for decades, Alston wrote, but have failed to implement policies that could mitigate the likely damage.

"Somber speeches by government officials have not led to meaningful action and too many countries continue taking short-sighted steps in the wrong direction," Alston wrote.

To illustrate this point, Alston cited Brazil's President Jair Bolsonaro, who recently promised to allow mining in the Amazon rainforest (one of the world's single largest carbon offsets), and U.S. President Donald Trump, who "presided over an aggressive rollback of environmental regulations, and is actively silencing and obfuscating climate science," the report said.

While policies like these move the world away from the U.N.'s goal of limiting global warming to 2 degrees Fahrenheit (1.5 degrees Celsius) above preindustrial temperatures, Alston notes several positive developments in the climate fight, including lawsuits against fossil fuel companies and the successful carbon emission reductions in more than 7,000 cities around the world.

Alston thinks this positive pushback is just a start. To avert climate catastrophe, this momentum must be translated into the creation of a global coalition of climate activists fighting for a "deep social and economic transformation," Alston wrote. To truly address the threat of climate change, the world economy needs to "decouple" fossil fuel production from massive profits, and instead focus on a shift to policies that reward sustainability.

The task will not be easy, Alston wrote, but neither is it impossible. The first step, he said, is "a reckoning with the scale of the change that is needed." Radical changes in policy, and the immediate creation of a safety net to help those individuals who will be most harmed by climate change, must follow, he wrote. Giving up on the challenge could not only doom millions to avoidable death, but also shake the world's fundamental beliefs about what it means to take care of one another.

Should the climate be allowed to warm without restriction, "human rights might not survive the coming upheaval," Alston wrote.

(ICID Bulletin)

Some Trees Could Worsen Droughts By Consuming Too Much Water

Jun 26, 2019 08:05 AM By Johnny Vatican

A number of plants and trees such as bananas and oaks use up too much precious but scarce ground water to cool themselves during droughts and, in the process, make droughts more intense.

New research published in the Proceedings of the National Academy of Sciences journal showed some trees could actually worsen a drought in their areas by soaking up far too much ground water. It was conducted by a team led by University of Utah biologists William Anderegg, Anna Trugman and David Bowling.

"We show that the actual physiology of the plants matters," Anderegg said. "How trees take up, transport and evaporate water can influence societally important extreme events, like severe droughts, that can affect people and cities."

The study showed how tree traits affect how well forests handle hot and dry conditions. Some plants and trees have an internal plumbing system that slows down the movement of water. This helps the plants minimize water loss when it's too hot and dry.

On the other hand, some plants have a system more suitable for emitting large amounts of water vapor into the air with the larger openings on their leaves. These traits determine how well trees and forests can weather droughts.

The study wanted to know how these traits affect drought itself.

"We've known for a long time that plants can affect the atmosphere and can affect weather," Anderegg said.

Exhaled water into the atmosphere affects the balance of water and heat on the Earth's surface, which fundamentally controls the weather. In the Amazon rainforest with its massive abundance of trees, all of that water vapor can jumpstart precipitation.

The researchers used information from 40 sites around the world to collect data on the flows of heat, water and carbon dioxide in and out of the air. They also listed what tree species were prevalent around the instrumentation.

Comparing that data with a database of tree traits allowed researchers to draw conclusions about what a tree's traits were correlated with more droughts becoming more intense.



Researchers discovered two important traits: maximum leaf gas exchange rate and water transport.

The former refers to the rate at which leaves pump water vapor into the air. The latter describes how much water a tree can move to its leaves. In cool regions, plants and trees slowed down water use in response to declining soil moisture.

In hot climates, however, some plants and trees with high water transport and leaf gas exchange rates lost more and more water in an effort to carry out photosynthesis and stay cool while depleting the soil moisture that was left.

"You end up getting to these conditions that are hotter and drier much faster with those plants than with other plants," Anderegg said.

DRIP IRRIGATION SYSTEM IDEAS YOU CAN BUILD YOURSELF

JUNE 26, 2019



Pinterest

You don’t have time to properly water your garden? Cathy Isom has some Do it Yourself Ideas for drip irrigation systems. That’s coming up on This Land of Ours.

Having a drip irrigation system can help keep your plants alive and thriving even when you aren’t around or if you’re planning to be away for awhile. But they can be costly if you buy them in the store. Instead, there are many do it yourself drip irrigation systems out there. And you may already have some of the equipment you need at home.



Pinterest

For example, the drip irrigation bottle. Perfect for small gardens, houseplants, and window boxes. Place a 2-liter bottle in the ground, upside-down, next to your plants. Cut the bottom out and it will drip and water your plants as needed.



Pinterest

Or, this simple system using leftover and rinsed out empty milk jugs. Use a drill to put multiple holes in the milk jug. Dig a hole and put the milk jug in the ground next to your plants. When finished, cover with dirt but leave space for the spout to be easily filled. It will secrete water as needed in the garden.



Pinterest

If you haven't heard of olla gardening before, prepare to have your mind blown. Ollas are basic clay pots. You place them in the ground next to your plants. However, you must leave the spout sticking out of the ground to easily fill them with water. Water will secrete through the walls of the clay jar and water your crops. It also helps to water your plants from the bottom instead of overhead because it keeps the foliage of the plants from becoming wet.



Pinterest

Pick the set-up which would work best for your gardening method and make it yourself to save both time and money.

I'm Cathy Isom… (ICID Bulletin)

GOVT. SEES $40B INVESTMENT POTENTIAL IN CLEAN ENERGY

Unveils Alternative Energy Development Policy 2019, abolishes upfront tariff

ISLAMABAD

The government has announced that it will invite bids for setting up renewable energy projects in the country in a bid to tap the investment potential of $40 billion.

In the new renewable policy, the government will abolish upfront tariff and replace it with competitive bidding to attract investors to enhance the share of renewable energy to 30% in the energy mix.

Speaking at a press conference on Wednesday, Federal Energy Minister Omar Ayub Khan unveiled the Alternative Energy Development Policy 2019, stressing that the country had potential for $40 billion worth of investment in renewable energy.

"The government is eyeing 30% renewable energy in the system by 2030 and together with hydroelectric power it will be 60-65% of the energy mix," the minister said while announcing the revised renewable energy policy.

He was of the view that the previous government had introduced expensive re-gasified liquefied natural gas (RLNC)-based electricity, which was costing around RS17.5 per unit and multiplied the circular debt.

"Investment has already started pouring in as the government has signed renewable energy agreements with 12 companies, which will bring $700 million worth of capital," he said.

The minister revealed that besides generating renewable energy, the investors were also interested in the manufacturing of solar panels and wind turbines in Pakistan. "Danish, Chinese and Japanese companies have expressed interest in the manufacturing of wind and solar equipment in Pakistan."

He reiterated that 80% of electricity feeders were free from load-shedding in the country as with the help of various measures an additional revenue of RS229 billion had been generated.

Talking about salient features of the renewable energy policy, Special Assistant to the Prime Minister on Petroleum Nadeem Babar said the upfront tariff had been abolished and now all future tariffs would be based on competitive bidding.

"The government will set the target every year and will invite investors to submit bids. As per the target, the share of renewable energy will be ramped up to 20% by 2025 and 30% by 2030," he said.

By 2025, the combined share of renewable energy and hydroelectric power would be 52% and by 2030 it would reach 63% of the energy mix, he added.

"Current renewable energy policy is totally different from the previous one as earlier investors used to choose the site, fuel and cost but now we have changed it,"

Babar revealed.

"Now, the government will provide the site, identify the type of energy and award contract to the lowest bidder."

Speaking on the occasion, the Power Division secretary said the policy would be sent to the Council of Common Interests (CCI) for approval.

"All the provinces have been given the basic role and more say in decision-making regarding renewable energy projects," he said.

Replying to a query on government-to-government agreements under the new policy, the secretary said such deals would be only for the under-developed areas in Balochistan and Gilgit-Baltistan while for the rest of the country, competitive bidding would be held.

Responding to a question about capacity payments to the wind and solar power generating companies, the special assistant on petroleum stressed that there would be no capacity payment in the new policy and the companies would be paid for energy generation only.

In response to a question on payment of damages to Turkish rental power company Karkey, the energy minister replied that no payment had been made to the company.

Regarding the Neelum-Jhelum project surcharge, he announced that it would be abolished soon but gave no deadline.

CURRENT ACCOUNT IN SURPLUS AFTER FOUR YEARS

Surplus at $99m in Oct due to narrowing trade gap, firm worker remittances

SALMAN SIDDIQUI

KARACHI

Foreign Direct Investment

Pakistan's current account surprisingly turned positive after a gap of four years as the inflow of foreign currencies surpassed the outflow by $99 million in October due to a notable reduction in imports and firm worker remittances.

"This is surprising. This is a very big news," BMA Capital Executive Director Saad Hashmi said while talking to The Express Tribune.

A continued reduction in imports due to the implementation of structural reforms like rupee depreciation, high benchmark lending rate and regulatory duty on imports had raised hopes for a further drop in the current account deficit in October. "However, no one had expected the current account to show a surplus," he said.

"Improved trade deficit - due to a significant fall in imports and better exports - and firm worker remittances helped turn the balance (of current account) into surplus in October 2019," he said.

The trade deficit in both goods and services narrowed 47% to $1.41 billion in October compared to $2.68 billion in the same month of last year.

Worker remittances were recorded at $2 billion in October compared to $2.06 billion in October 2018, according to the central bank.

A brief talk with experts suggested they were anticipating a current account deficit of around $200-300 million in the month under review.

The current account deficit had been $284 million in September 2019 and $1.28 billion in October 2018.

"The current account balance was last seen in surplus in September 2015," Arif Habib Limited Head of Research Samiullah Tariq said.

Cumulatively, in first four months (Jul-Oct) of the current fiscal year, the current account recorded a deficit of $1.47 billion. It was, however, 73.5% lower than the deficit of $5.56 billion in the same period of previous year, the SBP said.

The massive drop came due to a significant contraction of the trade deficit in Jul-Oct FY20. "The current account deficit narrowed, thanks to the trade deficit, which went down 37% year-on-year to $7.8 billion in four months compared with $12.4 billion in the same period of last year," he said.

Keeping in view the current account surplus in October, Hashmi said, external vulnerabilities had now been taken care of and the surplus had set the tone for economic stability and growth in future.

"We can expect a cut in the benchmark interest rate in the monetary policy to be announced on Friday (November 22)," he said.

The next challenge for the economic mangers is to accelerate economic growth. "The current slowdown in the economy is larger than expected. For example, no one had anticipated a massive fall in car sales," he said.

While structural reforms have helped turn the current account into surplus, they at the same time have adversely impacted the gross domestic product (CDP) growth. The central bank has anticipated a CDP growth of 3.5% for the current fiscal year, which is close to a nine-year low of 3.3% hit in the preceding fiscal year.

He said the surplus should help further build the country's foreign currency reserves. "Foreign debt repayment remains an issue. However, it has been taken care of in the IMF loan programme "

FDI at $650m

The current account surplus should also help improve the inflow of foreign direct investment (FDI) into different sectors of the economy like telecommunication, oil and gas exploration and power production.

"Foreigners should now feel comfortable and can invest in long-term projects in Pakistan on the back of a stable external account," he said.

FDI stood at $650 million in first four months (Jul-Oct) of the current fiscal year. It was 239% higher than the investment of $192 million in the same period of previous year, the central bank said.

The significant rise in the FDI came following a Norway-based cellular service provider, Telenor, partially paid its licence renewable fee of $224.6 million to the government last month. Excluding this, the overall growth in the FDI has remained sluggish in the four months under review.

"We have studied...FDI will gradually improve along with the sentiment," remarked SBP Governor Reza Baqir last week.

As soon as people started believing that the core issues had been addressed, the future outlook would turn positive, he said, adding "we are confident FDI will improve gradually."

WELCOME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering congress 75th Annual Session approved Membership of the following new members into the congress fold. The Engineering News Congratulates all of them and welcomes them to Pakistan Engineering Congress

Members admitted on 75th / 8th Meeting of Executive Council held on November 30th 2019.

Sr.#	Name	Father's Name
1	Engr. Muhammad Asif Mushtaq	Muhammad Mushtaq
2	Engr. Ali Ahmad	Munir Ahmad
3	Engr. Ali Asghar	Irshad Ahmed
4	Engr. Aamir Kaleem	Kaleem Ullah
5	Engr. Huzaifa Shafiq	Muhammad Shafiq
6	Engr. Ikramul Haq	Ch. Abdul Aziz
7	Engr. Faran Iftikhar	Syed Iftikhar Hussain Bukhari
8	Engr. Muhammad Meiwan Ashraf	Muhammad Ashraf
9	Engr. Tariq Ismail	Muhammad Ismail Naeem
10	Engr. Suleman Ahmad	Muhammad Naeem
11	Engr. Azhar Javed	Muhammad javed
12	Engr. Yousaf Khan	Said Rehman
13	Engr. Fawad Afzal	Muhammad Afzal Khan
14	Engr. Sobia Nazir	Muhammad Nazir
15	Engr. Mirz Farquleet Baig	Mirza Ayub Baig
16	Engr. Muhammad Jahanzaib	Zakir Rehman
17	Engr. Gohar Siddique	Muhammad Siddique
18	Engr. Nazar Hayat Khan	Abdul Ghani Khan
19	Engr. Saleem Khan	Ayyub Khan
20	Engr. Muhammad Fiaz	Abdul Sattar
21	Engr. Mehar Ayoub	Muhammad Ayoub
22	Engr. Rana Junaid Hassan Khan	Rana Nisar Ali Khan
23	Engr. Chaudhry Ikram Ullah	Mushtaq Ahmed
24	Engr. Imran Tufail	Muhammad Tufail Bhatti
25	Engr. Asif Nazir	Malik Nazir Ahmad
26	Engr. Rana Muhammad Umar Farooq	Rana Muhammad Ashiq
27	Engr. Hafiz Abdul Rehman	Abdul Sattar

Sr.#	Name	Father's Name
28	Engr. Muhammad Bilal Tahir	Tahir Mehmood
29	Engr. Sania Khalid	Khalid Hussain
30	Engr. Syed Muhammad Ali Naqvi	Syed Zulfiqar Hussain Shah
31	Engr. Waqas Abdul Wahid	Abdul Wahid
32	Engr. Ghulam Nabi	Naqal Shah
33	Engr. Ghulam Rasool Talpur	Ali Bux Talpur
34	Engr. Abdul Ghaffar	Ch. Fateh Muhammad
35	Engr. Muhammad Akmal Tahir	Dr. Muhammad Saleh Tahir
36	Engr. Muhammad Haroon-ur-Rashid	Abdul Rashid
37	Engr. Muhammad Asad Ali	Muhammad Asif
38	Engr. Muhammad Roheel	Rafaqat Ali
39	Engr. Habib-ur-Rehman	Gul Muhammad
40	Engr. Ali Murtaza	Sardar Ali
41	Engr. Muhammad Riaz	Abdur Rauf
42	Engr. Bilal Shabbir	Ghulam Shabbir Sangam
43	Engr. Usman Ghani	Farrukh Saeed
44	Engr. Umar Farooq	Farrukh Saeed
45	Engr. Abdul Basit	Muhammad Saleem
46	Engr. Muhammad Abdus Salam	Ch. Basharat Javed
47	Engr. Khurram Shahzad Khan	Muhammad Mushtaq Khan
48	Engr. Naeem ur Rahman	Saeed ur Rahman
49	Engr. Tahir Khalil	Arshad Gul
50	Engr. Malik Humayun Faheem	Malik Allah Nawaz
51	Engr. Rana Muhammad Ameer Hamza Khan	Rana Nasir Ali
52	Engr. Yasir Iftikhar	Iftikhar Ahmad
53	Engr. Sanwal Malik	Muhammad Azam Malik
54	Engr. Sabeeh Ali	Tanveer Hussain
55	Engr. Muhammad Aqib Javed	Muhammad Sadiq
56	Engr. Bilal Hummayoun Butt	Azhar Hummayoun Butt
57	Engr. Hafiz Muhammad Aubaid Asaad	Muhammad Qasim
58	Engr. Muhammad Saad Saeed	Muhammad Saeed
59	Engr. Azhar Yousaf	Muhammad Yousaf
60	Engr. Muhammad Saeed Younis	Muhammad Younis
61	Engr. Ayesha Nisar	Nisar Ahmed Janjua

Sr.#	Name	Father's Name
62	Engr. Muhammad Shahid	Ghulam Mustafa
63	Engr. Hafiz Abdul Munam	Nisar Abdul Rauf
64	Engr. Muhammad Aftab	Muhammad Ijaz
65	Engr. Muhammad Talha Arshad	Muhammad Arshad
66	Engr. Hafiz Awais Danish	Abdul Qahar
67	Engr. Syed Umair Rasheed	Syed Rasheed Gardezi
68	Engr. Syed Manzar Abbas	Syed Mubashar Hussain
69	Engr. Ahmad Zeeshan	Malik Nazir Ahmad
70	Engr. Muhammad Haroon	Abdul Waheed Khan
71	Engr. Shan-e-Ali	Sarfraz Hussain Javed
72	Engr. Jamal Yousaf	Muhammad Yousaf
73	Engr. Naqeeb Ullah	Habib Ullah
74	Engr. Najamul Huda	Molvi Moula Dad
75	Engr. Noor -us-Sabah	Umer Javed
76	Engr. Farooque Adil	Nooruddin
77	Engr. Asad Abid	Abid Rasool
78	Engr. Hassan Ahmed	Shamim Ahmed
79	Engr. Muhammad Hasnain Mangi	Abdul Manan Mangi
80	Engr. Hammad Aslam	Muhammad Aslam
81	Engr. Muhammad Rizwan Khaliq	Khaliq Dino Memon
82	Engr. Adil Ali	Arshad Ali
83	Engr. Zeeshan Liaquat	Liaquat Ali
84	Engr. Nazeer Ahmad	Ghulam Shabbir
85	Engr. Muhammad Ali Khan	Sanaullah Khan
86	Engr. Mir Muhammad	Muhammad Akram
87	Engr. Muqadas Shahzadi	Babar Mehmood
88	Engr. Syed Muhammad Mudassir Zia	Zia ud Din Shah
89	Engr. Tauqeer Akhtar	Muhammad Akhtar
90	Engr. Muhammad Wasay uz Zaman	Qamar uz Zaman
91	Engr. Dr. Farrukh Arif	K.M. Arif Rasheed
92	Engr. Mohsin Faryad	Faryad Ahmed
93	Engr. Ubaid Ullah	Abdul Halim

THE RIVER RAVI – A KILLER DRAIN

by

Dr Engr Mazhar Hussain

ABSTRACT

The river Ravi is a trans-boundary river flowing from India to Pakistan originating from the Himalayas in north-western India through Pakistan and is one of the five rivers which give the Punjab region its name has earned the moniker killer drain in its 60 km stretch through the city of Lahore. The river Ravi basin is heavily polluted with urban, industrial and agricultural waste which can lead to major human, health, food, and water safety risks. The river is biologically dead, lacking dissolved oxygen along much of its reach downstream of Lahore. River Ravi basin highlights ground and surface water quality deterioration, over extraction of groundwater, inequitable development leading to increased water stress and increase in waterborne diseases. The Integrated Master Plan of Lahore 2021 includes remedial measures for the waterway including a river Ravi Urban Development Project which will revive the water flow and protect the river from municipal waste through the installation of plants for the collection and treatment of wastewater. Ravi becomes a dirty drain during the drier winter months as the flow of water slows through this river Ravi so called killer drain, which contaminates groundwater and promotes the spread of harmful pathogenic bacteria in people. The river ecology has been decimated over the past 30 years which has negatively impacted on the socio-economic status and physical health of the communities living along its both banks. This paper highlights the river Ravi current situation and demand to take immediate measures to prevent the ecology and human life.

Key words: Agriculture, contamination, ecology, industrial, urban, Ravi, river basin

1.0 INTRODUCTION

The river Ravi is a trans-boundary river crossing northwestern India and eastern Pakistan. The upper reaches of the main Indus River and its tributaries lie in India whereas the lower reaches are in Pakistan It is one of six rivers of the Indus System in Punjab region (Punjab means "Five Rivers"). The waters of Ravi are allocated to India under Indus Water Treaty. Under the Indus Waters Treaty of 1960, the waters of the Ravi and five other rivers are divided between India and Pakistan. Subsequently, the Indus Basin Project has been developed in Pakistan and many inter-basin, irrigation, hydropower and multipurpose projects have been built in both the countries.

With a length of 680 km, the river Ravi is the smallest of the five main eastern tributaries of the Indus River. The river rises in the Himalayas at a height of some 4,000 m and then flows through the basin of Bangahal in India's Himachal Pradesh. It goes through the valley of Chamba, past Pathankot and Gurdaspur district before entering Pakistan at Shakargarh tehsil in Sialkot. The Ravi then flows over the Ravi Siphon, past Lahore and then to the headworks at Balloki, some 133 km

downstream from the Siphon. The Ravi River merges into Chenab River and then the Indus, which flows to the Arabian Sea.

As the Ravi flows past Lahore in Pakistan (26 km) below Amritsar in India), it is called "The river of Lahore" since that city is on its eastern bank. After passing through Lahore the river takes a turn at Kamlia and then debouches into the Chenab River, south of the town of Ahmadpur Sial. On its western bank is the town of Shahdara Bagh with the tomb of Jahangir and the Tomb of Noor Jahan.

The river Ravi enters in Pakistan at Jassar, about 120 km upstream of Lahore and joins the Chenab River near Kabirwala after flows down about 520 km. The average annual flow of the river Ravi in Pakistan territory was 7 million acre feet (MAF) during the period 1922 to 1961 but due to Indus Water Treaty of 1960 between India and Pakistan, right to use the water of this river were allocated to India. The average annual flow between 1985 to 1995 was recorded as 5 MAF which was further decreased to 1.1 MAF in years 2000-2009 due to construction of hydropower projects/dams on river Ravi by India. The river Ravi seems to be the main source of recharge in the North-West of Lahore. For the last two decades, Ravi River remained almost dry except in monsoon, so the recharging through river Ravi has seriously decreased.

1.1 Causes of pollution in river Ravi

About 50 million people live in the basin within Pakistan. This includes 24m urban dwellers in Punjab's major cities of Lahore and Faisalabad, and in about 70 other urban areas. The basin experiences huge flow variations, ranging from 10 cubic meters per second in the dry season to 10,000 cubic meters per second in the wet season.

Major pollution sources include household wastewater, industrial effluent, agricultural runoff and solid waste. The city of Lahore disposes of all of its municipal and industrial waste, untreated, into the river Ravi. The total disposal flow of wastewater into the River Indus and its tributaries has been estimated at 56.52 cubic meters per second (m^3/s) with a BOD (biological oxygen demand) load of 1,900 tons per day. Of this, the disposal flow of the River Ravi is 28.09 m^3/s with a BOD load of 885 tons a day.

In the stretch of about 133 km between the Ravi Siphon and the Balloki headworks, the city of Lahore effectively pollutes half of the water of the Indus River and kills the Ravi. The water of the Ravi, past Lahore, is unsuitable for recreation, extremely perilous to fish and wildlife, and harmful to humans. This contaminated water also mixes with irrigation water diverted at Balloki into the Balloki-Suleimanki link canal and is used for agricultural purposes. **Figure-1** shows the Indus River system comprises of the rivers, Ravi, Beas, Sutlej, Chenab, Jhelum and Indus. **Figure-2** depicts the view of river Ravi.

The city of Lahore, have about 11.1 million populations, water is extracted through 576 tube wells before pumping into the distribution system. Currently, the groundwater extraction by its responsible agency "Water and Sanitation Authority", Lahore is 540 million gallons per day (MGD), or equivalent to 2.45 million cubic meters per day. In addition, about 1.2 million cubic meters per day is extracted by private housing societies, cantonment boards, railway colonies and areas under the

jurisdiction of local government. In view of increasing demand due to ongoing urbanization and increased commercial activities, the numbers of tube wells is also increasing with every passing day. On the other hand, Lahore receives an average annual rainfall of about 715 mm, which does not contribute much in recharging the aquifer, as groundwater extraction is much higher than recharge. Consequently, the groundwater table continues to deplete rapidly. The current decline rate is observed at an alarming rate of more than one meter per annum. As a consequence, several existing shallow tube wells have dried up and are no longer operational, and the city has started facing severe water shortages.

All the untreated domestic and industrial wastewater is discharged directly in the nearby river Ravi and thus, heavily polluting the river. **Table-1** highlights the parameters of environment of various drains which show deteriorated water quality. It is estimated that River Ravi receives nearly 640 MGD wastewater as if converting a river into a sewage drain. On the other hand, River Ravi plays a major role in replenishing Lahore's groundwater by up to 82 percent. Due to mass contamination of the river, polluted water seeps down making the groundwater unfit for drinking purpose, and affecting soil fertility. The pollution of groundwater has been causing diseases like diarrhoea, typhoid, intestinal worms and hepatitis in several areas of the city.

Table-1 Parameters of environment of various drains effluent

Sr. no.	Para-meters	Unit	NEQS Value	Shah dara Drain	Mian Mir Drain	Iqbal Town drain	Garden Town Drain	Sattu kattl a Dr	Bab Sabu Dr	Out Fall dr	Guls h e Ravi
1	pH	-	6-9	6.8	7.9	6.8	7.8	6.9	7.8	7.5	7
2	Temp	^{0}C	40	20	21	19	22	20	22	18	15
3	TSS	mg/L	200	230	90	182	178	134	206	201	145
4	TDS	mg/L	3500	1170	790	780	790	810	800	280 0	940
5	Color	TCU	NGVS	156	79	504	350	104	342	618	771
6	COD	mg/L	150	362	299	503	349	295	385	641	340
7	BOD	mg/L	80	170	132	245	165	123	182	265	156
8	DO	mg/L	NGVS	0.6	0.8	0.9	0.7	0.9	0.5	1	0.8
9	Oil & Grease	mg/L	10	32	33	67	33	33	33	24	16
10	Chloride	mg/L	1000	256	61	85	64	110	60	692	123
11	Sulphate	mg/L	600	272	105	98	116	153	89	306	102
12	Calcium	mg/L	NGVS	71	94	60	54	84	90	98	65
13	Magnesiu m	mg/L	NGVS	49	44	61	39	50	65	70	45
14	Carbonat e	mg/L	NGVS	13	17	9	10	12	15	20	8



Figure-1: Indus River system- the rivers; Ravi, Beas, Sutlej, Chenab, Jhelum and Indus



Figure-2: View of river Ravi looking downstream from Ravi Bridge

2.0 RAVI WATER POLLUTION

The river Ravi is a trans-boundary river flowing from India to Pakistan, in urban areas of Lahore the pollution levels in the river discharge are very high, which is attributed to careless disposal of large amount of industrial and agricultural waste water and faulty drainage systems in both countries. A 72-kilometre stretch of the river Ravi from Lahore Siphon to Baloki headworks indicates heavy contamination of the water and sediment with Cd, Cr, Pt and Cu. The river sediments are highly contaminated and have become secondary source for pollution of the river water, even though some control over unauthorized discharges into the river has been checked. The measures to check metal re-mobilization from sediments into the river flows, needs attention. The worst affected drainage is the Hadharaam drain, a tributary of the Ravi River. It is also a trans-border problem involving both India and Pakistan.

The waters of the Ravi River are allocated to India under the Indus Waters Treaty, signed by India and Pakistan. Within India, the river is under the jurisdiction of the riparian states of Punjab and Himachal, and non-riparian states of Haryana, Jammu & Kashmir and Rajasthan, but the management is presided by the Supreme Court of India and the Ravi Beas Tribunal, set up in 1986 for the purpose.

In Punjab province, Ravi is cruelly affected by the indiscriminate dumping of untreated municipal and industrial effluents. With extremely low flows in the winter, the river turns into a dirty drain due to the discharge of municipal sewage from Lahore city as well as industrial flows from industrial clusters at various locations like Kala Shah Kaku-Lahore Sheikhpura Road, Kot Lakhpat Industrial Estate and Multan Road as shown in **Figure-3.** The Hudiara drain discharges maximum pollution load into the river about 12.17 m^3/s (430 ft^3/s). According to an estimate the total daily discharge into river Ravi from point and non-point pollution sources is 56.62 m^3/s (2000 ft^3/s) per day.

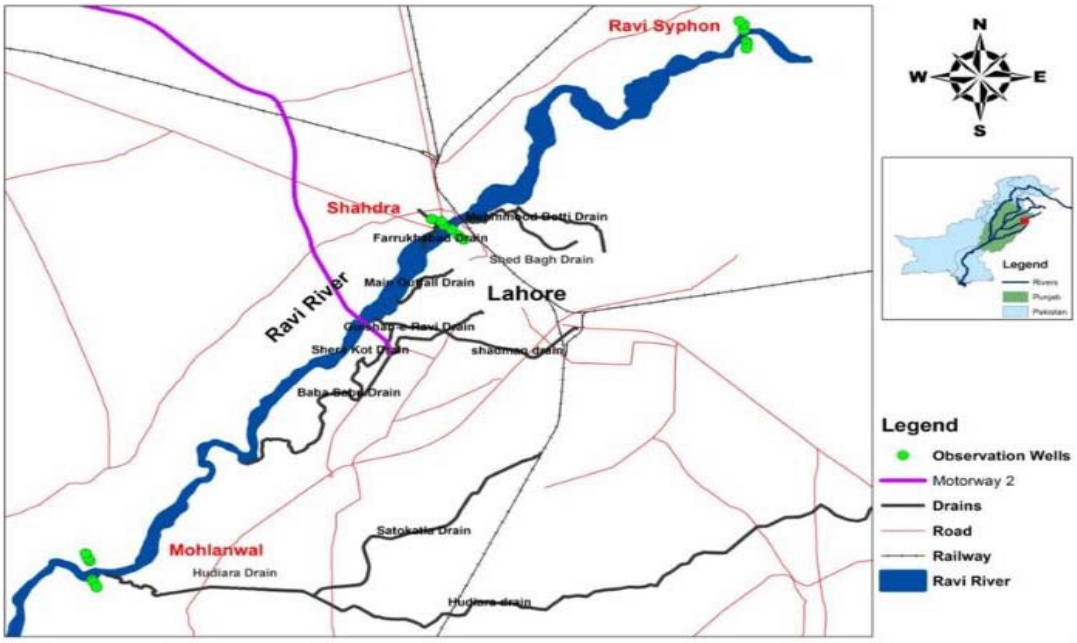


Figure-3: Various locations of drains outfall into river Ravi

Heavy metal contents, high arsenic level and sewage have been found in pumped groundwater due to pollution in Ravi and are causing diseases like typhoid, dysentery, cholera, hepatitis A and hepatitis C among citizens. The pollution level in River Ravi is constantly increasing as municipal waste from 11 main drains of the city and industrial waste from industrial estates in Kot Lakhpat, Ferozpur Road and Sundar are discharged without any treatment into it. Chemicals, food, plastic, poultry, paper, textile, leather, pesticides, paint and pharmaceuticals are some of the things that are dumped into the river by industries.

It is alarming that the use of Ravi waters for irrigation has been found to be severely harmful for the soil as well as crops. Various studies highlight the accumulation of harmful heavy metals in crops irrigated with Ravi waters. The pollution increases as the river flows from Jassar to join river Chenab, its quality deteriorates tremendously and it receives greatest pollutant load from Hudiara drain and Deg Nullah from district Lahore. Due to seepage of surface water, pollutants have penetrated into the ground water which has also become severely contaminated. In the areas where industrial drains are present the heavy metals like lead and nickel etc. have entered into the ground water and ultimately in the food chain. Faecal pollution is also common in these areas. This has resulted in increased incidence of diseases like diarrhea, abdominal infections and skin disorders. During low flow or zero flow from India the river is literally reduced to a killer DRAIN.

Of Ravi's total discharge of 28.08 m^3/s, 23.43 m^3/s is the municipal flow and 4.65 m^3/s the industrial flow. The annual flow has gradually declined over years. Between 1922 and 1961 it was 7 million acre feet (MAF), thinning down to 5 MAF, between 1985 to 1995, and further to 1.1 MAF between 2000 and 2009. Over 2009-10, it was 0.28 MAF. According to an international panel of experts, the flow should be a minimum 5000 cusecs per day and 25 MAF every five years. The gradual reduction in Ravi's flow over the past 20 years has brought about devastating effects on the river ecology, ground water quality, socio-economic status and the health of the communities settled along the banks.

The reduced volume of water in the river also leads to lowering of the water table along the banks as there is no recharge with fresh water. Recharge with sewerage water, on the other hand, is very much detrimental for human beings, livestock and crops. Farmers are using this polluted water for irrigation and milkmen give this water to their animals creating severe health problems. Typhoid, dysentery, cholera and hepatitis are water related diseases. According to World Health Organization, all five types of hepatitis are present in Pakistan. Hepatitis A and C are directly related to poor water and sewage system. The combined ratio of hepatitis B and C in Pakistan is 7.6 percent. **Table-2** shows the total dissolved solids (TDS) in various drains in Lahore outfall into river Ravi.

The entire municipal waste from Lahore is collected through a network of 14 main drains and discharged into the River Ravi without any treatment, increasing pollution level with every passing day. As many as 271 industrial units discharge their untreated waste into the canal system that ultimately ends up adding to the pollution of already heavily polluted River Ravi. These industries include textile, chemical, food processing, pulp and paper, poultry, dairy, plastic, paint, pesticides, leather, tanneries and pharmaceuticals.

Table-2: Total Dissolved Solids (TDS) in various drains in Lahore outfall into river Ravi

Sr. No.	Name of drains	Flow in ft^3/s 2008 (EPD)	TDS (ppm) 2008 (EPD)	TDS (ppm) 2010 (IRI)	TDS (ppm) 2012 (IRI)
1	Mehmood Booti drain	20.87	312	775	1117
2	Shad Bagh Drain	139	520	663	1067
3	Farukhabad Drain	219	1000	1088	1627
4	Budha Ravi Drain	41.99	690	1006	1100
5	Main outfall drain	193	560	627	1154
6	Gulshen e Ravi drain	246.5	660	897	1035
7	Babusabu drain	270.7	660	760	1135

Huge discharge of untreated domestic and industrial waste has turned River Ravi, the most important source for maintaining aquifer level in Lahore, into a dumping pit, causing serious health and environmental hazards. Besides taking agricultural waste from India, Hudiara Drain is carrying hazardous waste from over 100 industrial units in Pakistan that also ends up into the river Ravi. Out of these 100 industrial units located along Hudiara Drain, 30-35 are high polluting textile processing units, carpet industries, tanneries, food processing units and dairies that are gradually increasing the metal contents in water of River Ravi. The quality of shallow groundwater is poor that is affecting working of WASA tube wells by seepage from sewerage / drainage system. According to various studies, high metal contents and arsenic level has been found in the pumped groundwater that coupled with contamination of sewerage has put the health of the masses at a greater risk of getting diseases. The study indicates that nearly 48 percent of the overall pollution discharged into the River Indus comes from the river Ravi. As per a study recently carried out by WWF-Pakistan, the concentration of arsenic is much higher than the World Health Organization (WHO) standards at shallow water table depths of up to 30 m.

Lahore city is situated at the bank of River Ravi, which is receiving untreated industrial and domestic wastewater on a daily basis from various domestic and industrial drains. This water invades aquifers threatening the health of local residents]. Lahore is the second biggest city in Pakistan, where approximately 4,847,040 m^3/d (1,981 cusec) of wastewater is being discharged into Ravi. Key issues in treating this wastewater are the capital cost, inherent process complication and energy extensiveness of conventional wastewater treatment technologies.

Yusra Mehfooz et. al., 2017 made a study to quantify the pollution load entering into river Ravi from four major drains Gulshan-e-Ravi, Outfall, Babu Sabu and Hudiara drains, its impacts on water quality and to optimize the oxidation pond treatment for the surface area requirement, retention time and bio-mass concentration. Wastewater analysis of the drains indicate that among four drains, Hudiara receives largest amount of wastewater from almost 100 industries. Hudiara takes domestic and industrial effluent from both the Indian terrain and from Lahore.

Hudiara takes wastewater from the township industrial estate and goes eventually into river Ravi with an average discharge of 12.16 m^3/s (430.56 ft^3/s). Babu Sabu on the other hand receives most of its wastewater from communities and residential areas. Its average discharge is 4.69 m^3/s (165.7 ft^3/s). BOD was high (401 mg/L) at Babu Sabu drain and DO was 0.12 mg/L while COD was higher

(1,288 mg/L) in Outfall drain with DO 0.2 mg/L indicating the water is highly polluted. These readings were above the permissible limits. **Figure-4** depicts outfall of effluent of drains into river Ravi.

The study was based on the wastewater quality of the four drains (Outfall, Gulshan-e-Ravi, Hudiara and Babu Sabu) entering into river Ravi in Lahore, Pakistan. Pollution parameters were analyzed including pH, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD), turbidity, electrical conductivity (EC), total suspended solids, nitrates, phosphates, sulfates and fecal coliform. All parameters of drains exceeded the permissible level of wastewater standards. Hudiara drain showed the highest pollution load in terms of COD: 429.86 t/d while in Babu Sabu drain, highest pollution load was calculated in terms of BOD: 162.82 t/d. Lab-scale treatment (oxidation ponds) was designed to treat the wastewater of the Babu Sabu drain, through combination of different algae species, namely Chaetomorpha sutoria, Sirogonium sticticum and Zygnema. The study also concluded that algae-based treatment is the most energy efficient and cost-effective in improving water quality in drains.

Haider H., 2017, studied reach of the river Ravi of about 100Km between Ravi Siphon and Balloki Headworks to develop DO model for the river Ravi considering both the CBOD and NBOD. The river study reach is segmented based on locations of wastewater outfalls, surface drains and freshwater tributaries. Hydrodynamic model is developed to estimate travel time and reaeration coefficient for DO modeling of the river Ravi. Estimation of model parameters and waste inputs is carried out through a combination of laboratory measurements, field and monitoring data and sensitivity analysis. Long-term BOD analysis of the wastewater samples collected at five outfalls and two surface drains are made to determine the ratio between CBOD and CBODU, bottle rate coefficients and ultimate values of BOD, CBOD and NBOD.

Currently about 862,000 Kg/day of BOD pollution load is being discharged into the River Ravi. This total pollution (BOD) load will increase to about 1.5 times from different outfalls and surface drains by the year 2025 due to constant increase in urbanization and industrialization in the Ravi River catchments.

To improve the water quality of the River Ravi wastewater control alternatives including conventional wastewater treatment, flow augmentation, wastewater transportation, low cost treatment and constructed wetlands are evaluated. Model calculations carried out for water quality management of the River Ravi show that even to achieve 1mg/L of DO levels in the River Ravi at MA7CD flow (i.e., 9.2 m^3/s) 70% BOD reduction is required. Higher removal efficiencies of 85 and 90% are required for 3mg/L and 4mg/L DO levels respectively. To achieve 5mg/L of DO standards, high removal of both CBOD and NBOD (95%) is required. Ammonia toxicity is also a water quality problem in the River Ravi. The simulation results show that 90% ammonia removal is required to meet the desired un-ionized ammonia standards. This removal results in 5mg/L DO level in the River Ravi. A flow augmentation of about 19 m^3/s through MR Link canal with 80% of CBOD removal can achieve 4mg/L DO standards with 30% lower cost than the MA7CD flow conditions. Flow required to augment the river flow to achieve 4mg/L DO standards without any treatment is 416 m^3/s. The flow that can be diverted from MR Link canal

to the River Ravi will depend on availability of the water in the River Chenab and may require remodeling of MR Link canal.

Transportation of wastewater from the city of Lahore trough a collector channels with primary treatment facility at the confluence point of QB Link canal is a cost effective option with about 2.5 times lower cost than the alternative with ASP at all the outfalls and surface drains. Waste stabilization ponds as an alternative for water quality management of the River Ravi comes out to be the least cost alternative, but this result in DO level of 3 mg/L in the river.



Figure-4: Pictorial view of outfall of effluent of drains into river Ravi

3.0 ENVIRONMENT PROTECTION REGULATORY FRAMEWROK

Pakistan, with a population of over 207 million people, is the world's sixth most populous country. Several factors, including rapid population growth, industrialization, urbanization, and motorization, have resulted in growing environmental degradation and pollution.

The Pakistan Environment Protection Act of 1997 (PEPA) has been enacted. The PEPA allows for the notification of National Environmental Quality Standards (NEQS) to be enforced by the Pakistan Environment Protection Agency (Pak-EPA) and provincial EPAs. In August 2000, the ministry of environment notified the NEQs for municipal and liquid industrial effluents.

The water quality of the Ravi exceeds many of the NEQs prescribed. The untreated disposal of domestic and industrial waste into the river is a violation of the PEPA and of our Fundamental Right to Life. It is incumbent on the EPA, the Government of Punjab and Lahore's Water and Sanitation Agency to take action to enforce the law.

The EPA has, in the past, issued notices to industry and housing schemes for violating the PEPA by disposing of liquid effluent in excess of the NEQs.

4.0 REMEDIAL MEASURES BY STAKEHOLDERS

Presently the River Ravi is receiving about 3,400,000 m^3/day of wastewater form both domestic and industrial sources. Due to discharge of this large volume of wastewater, most of the Ravi River reach between Siphon to Balloki Headworks has become anaerobic and requires urgent implementation of a water quality management strategy.

The groundwater level of Lahore is depleting at a rate of 0.76 m (2.5 ft) to 0.914 m (3 ft) per year. The water table of central Lahore had fallen below than 39.62 m (130 ft) which means that it will drop below 70.1 m (230 ft) by the year 2025. Currently, more than 160 million litres of groundwater is extracted per day through hand pumps, motor pumps and tube wells in addition to the amount of water used for the industrial and recreational purpose.

The chemicals, food, plastic, poultry, paper, textiles, leather, pesticides, paint and pharmaceuticals are some of the items that end up in the Ravi. Various studies indicates that that dangerous heavy metals, high arsenic levels and sewage in the Ravi are causing diseases such as typhoid, dysentery, cholera and hepatitis A and C.

In the past regime, a committee comprising finance, irrigation and housing secretaries to check pollution in Hudiara drain was formed. The committee met several times. The PC-1 was framed and the treatment plants require checking pollution in river Ravi, but further activities are unknown.

The different Punjab Government departments like Environment Protection Department (EPD), Water and Sanitation Agency (WASA) and Lahore Development Authority (LDA) has worked on various projects regarding rehabilitation and improvement of river Ravi water. The details are as under:

4.1 Environment Protection Department (epd)

Environment Protection Department (EPD) is mainly a regulatory body. It does not receive funds for the construction of treatment plants. The Water and Sanitation Agency's (WASA) has the responsibility to treat municipal waste and to keep a check on it.

EPD has engaged in a court case against WASA in environmental tribunals over pollution in River Ravi. WASA itself faces financial constraints, requiring Rs 50 billion to clean River Ravi. EPD is also fighting cases against industries as violated environmental laws. EPD is like a law enforcement agency and fines industries and departments which violate the respective laws.

4.2 Water and Sanitation Agency (WASA)

WASA has acquired 7,300 kanals of land near Babu Sabu to plan to install 11 treatment plants to make River Ravi pollution-free. WASA is aware of the pollution level in Ravi and has planned to install treatment plants in two phases. Four plants are planned to be installed in the first phase – two between Railway Bridge and

Motorway, one in Shad Bagh and one in Mehmood Booti area. WASA also has planned to install 35 to 40 treatment plants in Babu Sabu near Thokar Niaz Baig.

4.3 Lahore Development Authority (LDA)

Lahore Development Authority (LDA engaged an international firm to conduct feasibility study for Ravi Riverfront Urban Development Project, a mega project of developing a new city at a lengthy stretch along both sides of the Ravi. The Ravi Riverfront Urban Development Project is a part of the proposed master plan for Lahore. The report also gives recommendations regarding the master plan. Recommending requirements of the master plan of the Punjab capital, the report seeks removal of the existing wastewater flow into the river, developing a new wastewater system, an engineering solution to the annual flooding problem, a waterfront for the city, comprehensive master plan, enhancing living opportunities and modern transportation system, new industries to overcome unemployment challenges, removal of toxic and public hazards present in the existing river and creating a social, organizational, operational and living setting that supports and enhances the development of economic and the advancement of public life in Lahore.

The report also indicates some challenges regarding retaining water in the Ravi during winters as one of the biggest challenges to the launch and accomplishment of the Ravi Riverfront Urban Development Project. The Ravi River is not a recurrent water body because its source is being controlled by India under the water treaty of 1960. In summers, water releases in the river from Marala-Ravi Link Canal through Marala headworks, but in winters this canal is closed. So it is one of the greatest challenges to get water in the river in winters. The other major challenges to the project are about the discharge of existing wastewater of Lahore directly into the Ravi. The flow of wastewater into the river varies from 1.84 m^3/s (65ft^3/s) to 16534 m^3/s (584,000 ft^3/s). Wastewater identified as another hurdle to riverfront project.

The report discussed the project and its environmental objectives, calling for restoration of the river's ecology and natural habitats as per national and international standards. The objectives of the project include formation of pollution-free land, air and water as per Pakistan Environmental Protection Act (PEPA)-2012, rehabilitation of the river to an environment-friendly, at least maintaining irrigation surface water standards, creation of bacteria-free water bodies as per national standards, initiation of a 'green city, green mind and green hand' campaign to achieve restoration of the ecology, identification of the ways of environmentally improving the project by preventing, minimizing, mitigating or compensating any adverse impacts and development of an environmental management plan.

4.4 Irrigation Research Institute (IRI)

Irrigation research Institute (IRI) Punjab has studied in 2014 to evaluate the impact of pollution on underlying groundwater. For this, an experimental setup was laid in the field especially along river. Fifty piezometers in the shape of three batteries perpendicular to the River, one just on the edge, 2nd at a distance of 500 ft and 3rd at a distance of 457 m (1500 ft) were installed on both sides of the river Ravi at three sites viz Ravi Syphon, Shahdra bridge, and Mohlanwal. Each battery consists of three piezometers, each of 15.23 m (50ft), 30.47 m (100ft) and 45.71 m (150ft) depth below ground level. The four dimensional (along the river, across the river, vertically

downward and w.r.t time) trend of groundwater levels and quality was monitored and evaluated. Analysis of data observed indicates that groundwater quality is deteriorating with the passage of time especially at Shahdra Bridge (Lahore) site. Results revealed that quality of groundwater is deteriorating, moving downstream from Ravi Syphon to Lahore and then again improves towards Molanwal.

4.5 River Ravi Commission (RRC)

The LHC's Green Bench had formed the River Ravi Commission (RRC) on March 1, 2013 on Kamil Khan Mumtaz's petition. The commission had submitted a report to the court recommending that Ravi's water be treated using a constructed wetlands model. According to the commission's recommendation, WASA would allocate 50 acres of land at Babu Sabu for a demonstration constructed wetlands with a discharge capacity of about 0.283 m3/s (10 ft3/s) at a cost of Rs50 million.

In 2012, a Writ petition was submitted to the Green Bench of Lahore High Court (A bench formed by Chief Justice in High courts to hear all issues related to the environment) based on the issues of discharge of untreated municipal and industrial wastewater into the River Ravi. Petitioners submitted that the Ravi was a perennial and most polluted river in Pakistan. The river received wastewater from Shadbagh, Shahdara, Main Outfall Road, Babu Sabu (Gulshan-i-Ravi), Multan Road, Deg Nullah and Hadiara Drain pumping stations. As a response to this writ petition, Lahore High Court made a Commission for reviving the ecology of river Ravi. Advocate Ahmed Rafay Alam is the commission's secretary and RRC Chairman is Dr Kausar Abdullah Malik.

The Commission has members from the Provincial Government Departments (Water and Sanitation Agency, Environmental Protection Department, Punjab),Non-Governmental Organizations (WWF-Pakistan) and experts from environmental organizations to find a solution for controlling pollution in River Ravi with some practical and feasible outcomes using indigenous technologies. Lahore High Court set up a commission to investigate and recommend solutions to the issue of rising water pollution in river Ravi. The commission reported between 1200 and 1400 small and big industrial units as dumping their chemical and medical waste into the river. It recommended imposing heavy fines on the responsible industries and building a bioremediation plant at Babu Sabu to clean contaminated water. Bioremediation is the use of microorganism metabolism, plants and enzymes to remove pollutants from water. This project will cost Rs 45 million. Now from where would this fund be made available is a question.

Legally these factories are bound to have a wastewater treatment plant. However, the legal binding has been so weak that anyone could easily escape it: By imposing a meagre Rs 4,000 fine annually for not setting up the treatment plant, the authorities cannot hope to overcome this problem. This decision of the commission adopted by the LHC could not be hailed as a complete success to prevent polluted water flowing into the river and affecting ground water and food quality. It is a piecemeal approach that would still affect human lives. The best approach would be to tighten the noose around the necks of industry owners by revamping the law to make it more stringent and punitive.

5.0 RECOMMENDATIONS AND CONCLUSIONS

Following are the recommendations and conclusions:

(i) The concerned Governments Departments should take immediate concrete steps to save aquifer and river Ravi from further pollution and toxicity. The dual problems of clean water shortage and untreated wastewater overflow have become very serious and require urgent attention by all concerned stake holders.

(ii) Public awareness campaigns should be started in order to educate people about the role they can play in managing the problem and warning sign boards should be installed at important points along river Ravi on both banks.

(iii) Pakistan is a water-stressed country and the situation will worsen in the near future. The safe drinking water in rural and urban areas is declining. The industrial units around the city are a major factor in contaminating groundwater as they keep disposing water contaminated with copper, chromium, and nickel. So proper check and monitoring system is important and should be implemented immediately.

(iv) The rainwater harvesting models should be implemented on emergent basis on large scale and such artificial groundwater recharge can be a good option in restoring Lahore's groundwater.

(v) Environmental laws relating to protection of water resources should be strictly implemented. Discharge of untreated domestic as well as industrial wastewater into the river Ravi should be strictly curbed.

(vi) The safe drinking water should be made available to the population while the industries need to ensure proper disposal solid and liquid waste. This requires for immediate actions in making and implementation of the policy before it is too late.

(vii) The main source of recharging groundwater is the Ravi which is contaminated with polluted water that is hazardous. The contamination of river Ravi not only threatens individual health but also to economic growth, food security and environmental sustainability. The city of Lahore may face acute shortage of water in the near future if the depletion of groundwater continues with the present trend. The absence of water policy and rapid growth in urbanization are adding to the situation, making it more vulnerable.

(viii) The Environment Protection Agency (EPA) should strictly implement the National Environmental Quality Standards and force industries to install treatment plants. They should carry out random checks to monitor the regular working of the treatment plans.

(ix) Over the last 30 years Punjab has implemented several policies, regulations, and interventions to address environmental challenges. However, the lack of effective environmental governance and comprehensive green growth strategies and of instruments to promote green investments is an obstacle to reducing pollution discharges from all sectors and promoting the sustainable development of the province.

(x) A proper detailed investigation/research using groundwater flow and solute transport modeling approach in this regard is required to recommend the ways and means to replenish the groundwater reservoir to cater for the ever increasing stress on groundwater reservoir.

(xi) The concerned departments should make regular monitoring of Surface water and ground water in order to study the trends in surface and groundwater pollution.

(xii) At all discharges points of effluent into river Ravi, monitoring check posts needs to be installed for regular watch.

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LEACHATE POTENTIAL TO CONTAMINATE THE GROUNDWATER IN THE VICINITY OF LANDFILL SITES

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Abstract:

This review article talks about the different methods for the assessment of groundwater contamination used in different countries around the world. Different methods are highlighted on the basis of their suitability for the particular country to assess the quality of groundwater and the composition of leachate. A case study of Pakistan is also included that was conducted near a landfill site to observe a correlation between the leachate and the groundwater contamination in the vicinity of landfill site. This study indicated that TDS and turbidity values were exceeding the standard limit at every depth of water and the most variation was observed to be in shallow water. For shallow, moderate and deep level of water the highest values for turbidity was recorded as 10.1 NTU, 8.4 NTU and 4.5 NTU respectively. The coefficient of correlation was also observed between the leachate and the groundwater at moderate, deep and shallow depth.

Introduction

Overtime many techniques have been developed for the assessment of groundwater contamination. Two methods are commonly used that are, mathematical modelling and experimentation, focused on determination and estimation of impurities. From site to site the composition of leachate changes greatly or can changes in a specific site (Moo-Young H, 2004).

Groundwater is transparent, colourless, tasteless and odourless, liquid at normal temperature and chemically neutral in reaction and a universal solvent for many compounds. Just by assessing physical, chemical and biological characteristics of water we can conclude about its quality. Groundwater quality focuses on the various aspects of physico-chemical parameters of water that detect the status of pollution and suitability of a particular water body for various aquatic organisms. Ground water contamination is commonly defined as any physical, chemical or biological change in water quality which have an adverse impact on living organisms and the environment. (Sarker, 2013)

This research belongs to the study area Athens, Greece it was supported to observe the consequence of landfill leachate under the ground water resources present in that area. Physico-chemical parameters were observed for this purpose like heavy metals from the different sampling sites from up to 3 km of study region. The results found suggested that the quality of ground water was seriously deteriorated due to leachate contamination from the landfill. Two methods were adopted in this study the

experimental determination of pollutant or mathematical modelling for their estimation. Experimental determination was preferred due to lack of presence of parameters required for the mathematical modelling. (M. Loizidou, 1993)

A research was conducted in China to determine the detrimental effects on ground water quality of leachate percolation. The main strategy of this study was to determine stable isotopic compositions of water and various physicochemical parameters in groundwater and surface water. The stable isotopic composition revealed that there were many activities of evaporation processes and elevation effects before the saturation zone was reached by the water and no significant heavy metal contamination was found in that area. A method called Principle component analysis was used to determine TDS, Cl^-, NH_4^+, Mn and Fe concentrations were the main indicators of the contamination of groundwater caused when the landfill leachate percolated the ground water. Irrigation return flow is a major determinant of the quality of ground water shallow aquifer during the summers. A transport model was developed using MODFLOW and MT3DMS that gave us an adjective-dispersive two dimensional model to extrapolate the extent of control in the contamination. The study showed that even after 13 years of operation the contamination plume was observed to be present in the upper aquifer as the results were obtained by transient flow models and chloride transport simulations with steady state. This difference between concentrations shows that the other factors might have had a possible contribution to increase the salinity of aquifer. The transient model shows that the certain factors like temporal water variations might greatly effects the movement of plume towards the aquifer. The results obtained showed that the ground water around this facility was not suitable to drink. (Dongmei Han) Similar study was performed for an open dumpsite in Telangana State, India where ground water samples were collected and analysed for groundwater contamination due to leachate. (Syeda Azeem Unnisa, 2017)

In this research Fe_3O_4 nanoparticles were used that were made highly active after modification with Ag and were then used to analyse photo catalytic degradation in landfill leachate and Surface enhanced Raman scattering (SERS). Signals generated from SERS was used to determine the composition of leachate and the common pollutants presents in it that were observed to be heavy metals, pesticides, phthalates, phenols. The thought that the homeland aquifers were facing landfill crisis was also confirmed by the SERS signals. The decomposition of leachate was also observed to be efficient by the use of Ag modifies Fe_3O_4 nanoparticles, the degradation was observed to be carried out at a constant rate of .003 per minute under the access of UV radiations. In the recent years SERS have caught much attention of the scientists due to their ability detect and distinguish between various types of analyte present in a medium. Its dependency on the vast Electromagnetic (EM) development carried through the noble metals that have been modified and restructured makes it an extremely sensitive technique to carry out. This feature makes it an efficient tool to carryout analysis of certain single molecules in addition to their detection. When an analyte is situated in close proximity with the metal surface then the SERS efficiency is enhanced. Due to high surface to volume ratio Iron oxide nanoparticles had proved to be an efficient tool for the waste water treatment research. (Aarthi A., 2018)

SERS sign of landfill leachate determines the existence of communal pollutants in leachate. SERS signal is observed when an analyte get closed to the surface of metal surface. Improvement of signal depends on a large area of analyte. (Arthi A., 2018)

A new type of SERS dynamic substrate of Ag modified iron oxide was created to exhibit both the photo catalytic degradation and SERS. The achieved SERS signals from the samples established the landfill catastrophe in home aquifers. Moreover Silver modified Iron oxide NPs greatly decomposed leachate under UV irradiation with the rate of 0.003/min. The communal pollutants of heavy metals, pesticides, phthalate and phenols were identified by SERS substrate silver modified iron oxide from the groundwater and leachate. This method has been tried professionally with real samples, and its results suggest that because of doubtful design of the landfill the samples of groundwater were contaminated. Thus, silver modified Iron Oxide may play an important role of different applications, which includes the removal and identification of environmentally harmful substances to develop the human environment. (Arthi A., 2018)

The frequently used techniques for removal of solid wastes includes; dumping and landfills. But, landfilling can be seen as a potential source of land pollution. Therefore, even though landfilling is practiced, still the areas should be constantly monitored even after closure.

The breakdown of waste by microbes leads to formation of leachate which is enhanced by the rainwater that percolates through the solid waste. In landfills, without proper perimeters, the organic and inorganic matter migrates to unsaturated area, crowding it.

These days, for the geo-environmental persona of a site, non-invasive and non-crowding techniques can be used e.g. surface geophysics which supplies an outline of the area, supplying information for guidance.

Still, it is necessary to accentuate the results provided from the geophysical techniques are not convincing. Therefore, this data combination along with well monitoring are suggested for the confirmation of resistivity of groundwater which can alter due to porosity of rocks, contents of aqueous fluid and air, along with chemical changes in water. (Deiz Dias Lopes, 2012)

Over the whole life of HWL (hazardous waste landfill) Contamination of the groundwater due to leachate is the mostly destructive environmental impact. Considering the increasing HWL facilities and poor environmental risk management, it is needed to develop a appropriate methods for environmental management.

A risk analysis method for hazardous waste landfill is effective and efficient. The basic structure was formed considering five important aspects i.e. Landfill management and risk acceptors, properties of leachate, media present underground and source term. From multimedia models it was discovered that planned system was quantitative and integrated and records for it can be composed and used for ERA in china.

Official data (MEP2011) give the 15.87 million tons calculated amount of hazardous waste in 2010 but it comes out to be 45.73 million tons in 2007. To deal with this

huge quantity of waste, more landfill services needed for this and this increased due to industrial plants and abandoned hazardous chemicals. To fulfil this need, China planned many landfills for hazardous waste and their production plan accepted in 2004.Thirty one centres were included in management program and all complying with the relevant standards. In 2010, two hundred thirty seven medical waste and hazardous waste central disposal facilities and resulting HW settlement capacity 96.41*104 tons per year hence reached more than 4 times of previous one. (Ying Li, 2012)

To some extent, environmental crisis can be controlled at primary level but it's not that much easy and expensive as of HWLS in short time is. In china ERM is weak but recent environmental incidents raised alarming situation and this guidelines have been promulgated for its promotion i.e. due to defective risk analysis method. The new central hazardous waste dumping facilities were built in the deficient of standards and absence of experience. Thus requirement for development of environmental risk managing system arises.

By Many research studies it is proved that one main effect of landfill is groundwater contamination and considering it many assessments were carried out using different methodologies i.e.

1. transport characterization and degradation of leachate
2. observation of plumes of leachate near the landfill site
3. Laboratory experiment
4. Simulation by using mathematical models

These are applied in combined form in assessment and only last method give synthetic results and require detail data for modelling. These models are established from assumptions from real situation but they always results in uncertainty. Method 2 can also be used for actual contamination and mapping of the leachate movement but this is not reliable for long term pollution scenario. Method 1 is used for investigation of processes of waste decomposition outside HWL and method 3 results in deductions that are usually limited and distorted to the laboratory scope; a considerable results is usually achieved by repeated experiments.

This study tries to improve an efficient risk analysis method for more user-friendly but financial and human resource investments are the hurdles in developing simple and convenient risk analysis method and its results can be useful at macro level.

Indices system is always investigated from site choice, analysis of ground water, evaluation of leachate pollution, vulnerability of environment and decision making For the evaluation of leachate pollution, index of assessment are selected by the characteristic pollutant in leachate and contaminating the groundwater. Groundwater vulnerability is investigated by focusing on characteristics of underground environment. HRS and NCAPS are systems developed for assessing relative threat due to discharge of hazardous wastes and ranking the facilities. After those two environmental indicators that is groundwater EI and human exposure EI were established but are not adequate so, a synthetic analysis indices system is required for analysis of pollution of groundwater, management and operation of landfill and the guidelines required for landfill design,. (Ying Li, 2012)

The purpose of this method was to use the geophysics to determine water pollution, which is formed due to the percolation of leachate in landfilling. The aim of this study was to recognize the plume of leachate (leaching liquid) by the use of two techniques that is sampling of groundwater and geophysical technique for the sole purpose of determining the extent of contamination in groundwater. After using geophysical techniques, the leachate was final. The samples were tested for; heavy metals, TKN, alkalinity, chemical oxygen demand, conductivity, biological oxygen demand and pH. Through the electro-resistivity, morphology of the plume was finally determined. This was important for the water monitoring wells. These results indicated the correctness of geophysical study. The high values of electrical conductivity and alkalinity proved the water of those areas to be polluted by the plume. Even with the changes in seasons and environment, B BOD remained low comparing it to Brazilian environmental regulations. On the other hand, COD values are greater than 40x BOD. Moreover, the amount of copper (Cu), cadmium (Cd), zinc (Zn) and nickel (Ni) in water are lower than required standard amount as established in Brazil, but, Lead (Pb) concentration is higher than established by Brazilian legislation. (Deiz Dias Lopes, 2012)

Not having proper septic system and unlined landfill cause risk to surface water and groundwater resources. This study includes examination of plumes of leachate at landfill in sandy type aquifers, and the special effects of landfills on clay until settings. However; it's yet not properly understood. Furthermore, effective techniques are required to quantitatively connect groundwater soil impurity to the contamination of surface water.

This research was carried out in an ancient landfill that was unlined called Risby landfills. By the use of combination of mass balance method approach and historical investigation this study provides a method for the estimation of the contaminant mass discharge. The method seems to very well work at the level of screening level and it can be a part of risk analysis.

Pollutant mass discharge was determined for ammonium, dissolved organic carbon and chloride that are three common leachate indicators. For example, the chloride mass discharge was 9.4 tons per yr. from landfill whereas; to deep aquifer of limestone it was 1.4 tons per yr. Which as a result shows raise in amount of leachate indicators e.g. ammonium, dissolved organic carbon and chloride, in groundwater total discharge of chloride to small part of the landfill was about 31 kg per yr. By dissolving organic carbon, this method worked perfect for chloride however, due to reduction process and spatial difference in composition the errors were raised for ammonium in the underlying clay till. (Nanna I. Thomsan, 2012)

The use of "sanitary landfills" in Mexico is mostly based upon open dumpsites or uncontrolled landfills. Interaction of aquifers - shallow and unconfined - with the contaminants from open dumps or landfills is a common phenomenon seen in the country. This research article might provide as an evidence for Mexican decision makers to make decisions and set their opinion regarding the contamination of shallow groundwater aquifers. For the identification of contaminants and their access to the shallow ground water aquifer mostly traditional methods were used like hydrological description, chemical analysis of water, (VES) vertical electrical

sounding and (GPR) ground penetrating radar) used in geophysical studies. A model study site was taken that was in Mexicali – The Guadalupe Victoria landfill.

Geophysical studies of the area showed that the extent of the movement of leachate was recorded to be 20 meter from south-east edge and 40 meter from the north-west edge. The land that was influenced by the leachate was recorded to be 80 m extent from both sides of the leachate released from the landfill. The effects of leachate on the groundwater were calculated from the geochemical analysis. (Jaime A. Reyes-López, 2008)

A contract was made by the government of Alexandria with an international company to carry out the operation of collecting, transporting and discharging of solid waste to the landfill site. Duties of operation and construction were also included in this contract for the successful operation of the landfill. After the operation of landfill the groundwater and leachate quality was analysed to observe any harmful impacts of the landfill on the environment. A physico-chemical analysis was conducted that generated results suggesting a serious contamination of heavy metals and other harmful chemicals into the leachate. The ration between the BOD and the COD was observed to suggest the biodegradability and the instability of the leachate. Groundwater contamination was not observed in the surrounding area after calculation; certain parameters were observed but not harmful to exceed the EPA and WHO limits. The results obtained suggested that the anaerobic biodegradation was needed to be increased to stabilize leachate and continuous monitoring of groundwater and leachate was required for the successful operation of the landfill. (Magda M. Abd El-Salam, 2015)

A Case Study of Pakistan:

Leachate Analysis

The values obtained from the analysis of leachate samples are shown is Table 1. The pH of the samples ranged from 8.27 to 9.18. The samples exceeding the standard limits of pH were 30% given in NEQs that is 9. Electrical conductivity of leachate was recorded for only one month. The value obtained was 32030 µS/cm. The concentration of TDS in leachate exceeded the standard limits and had a mean value of 18889 mg/L. It was observed to be more than 5 times higher than the given limits in NEQs for TDS. TSS have its values ranging from 60 mg/L to a maximum of 920 mg/L. 33% of the samples exceeded their standard limits for the TSS that is 400 mg/L. BOD and COD for the leachate were observed to have a mean value of 1715 mg/L and 7433 mg/L respectively. COD was increased than the standard limits for all the samples but for BOD the samples exceeding their standard limits were 7%. Sulfate in the leachate was recorded to have a maximum value of 10400 mg/L that is nearly ten times higher than the given standard value. The concentration of chloride in the leachate had a mean value of 5504 mg/L, five times higher than the standard value.

Maximum value of cadmium was recorded to be 0.15 mg/L slightly higher than the standard value. The concentration of iron was recorded to higher than the standard value for 15% of the samples having a maximum value of 14.1 mg/L. Manganese and boron had their values well above the standard limits having maximum value of 11.8mg/L and 15.2 mg/L respectively. Half of the samples in case of zinc had slightly higher values than the standard limits and for Nickel higher value was recorded for

only one sample. Total toxic metals were recorded to be seven time higher than the standard value. Samples that had a higher content of phenolic compounds than the standard value were 50%. The value was observed to be maximum of 0.418 mg/L. The concentration of total chlorine, cyanide, selenium, barium, silver, copper, mercury, arsenic, chromium was recorded to be within the standard limits.

Table 1: Analysis of leachate and groundwater quality

	Leachate Quality Analysis			Groundwater Quality Analysis		
S. No.	**Parameters**	**Unit**	**Mean Values**	**Parameters**	**Unit**	**Mean**
1	**PH**	PH Unit	8.82		PH Unit	7.5192308
2	**Electrical Conductivity**	µS/cm	32030	**pH**	TCU	10
3	**TDS**	mg/L	18889.846	**Color**	_	
4	**TSS**	mg/L	356.33333	**Taste**	_	
5	**Oil & Grease**	mg/L	22.166667	**Odor**	NTU	16.130769
7	**COD**	mg/L	7433.2308	**Turbidity**	mg/L	279.15385
8	**Phosphate, Total**	mg/L	50.05	**Total Hardness as CaCO3**	mg/L	461.30769
9	**NH3, Nitrogen**	mg/L	505.1	**TDS**	mg/L	0.0992308
10	**(BOD5) @ 20 °C**	mg/L	1715.3077	**Fluoride**	mg/L	3.2607692
12	**Sulfate**	mg/L	1190.4692	**Nitrate (NO3), Nitrogen**	mg/L	0.0725385
13	**Sulfides**		5.6458333	**Nitrite (NO2), Nitrogen**	mg/L	30.956154
14	**Chloride**	mg/L	5504.9954	**Chloride**	mg/L	0.0033333
15	**Fluoride**	mg/L	1.8783333	**Aluminum**	mg/L	0
16	**Ionic Detergents**	mg/L	3.0255	**Antimony**	mg/L	0.0342857
18	**Arsenic (As)**	mg/L	0.034375	**Barium**	mg/L	0.1054545
19	**Cadmium (Cd)**	mg/L	0.063	**Boron**	mg/L	0
20	**Chromium (Cr)**	mg/L	0.1153846	**Cadmium (Cd)**	mg/L	0.0047273
21	**Copper (Cu)**	mg/L	0.2061538	**Cyanide**	mg/L	0
22	**Iron (Fe)**	mg/L	4.9115385	**Mercury (Hg)**	mg/L	0.0035
23	**Lead (Pb)**	mg/L	0.0554615	**Nickel (Ni)**	mg/L	0
24	**Manganese (Mn)**	mg/L	1.5566154	**Selenium**	mg/L	0.0066667
25	**Nickel (Ni)**	mg/L	0.3708333	**Phenol**	mg/L	0.0661111
26	**Zinc (Zn)**	mg/L	3.7730769	**Zinc (Zn)**	mg/L	0.1134167
27	**Calcium**	mg/L	44	**Manganese (Mn)**	mg/L	0.0304167
28	**Sodium (Na)**	mg/L	2900	**Chromium**	mg/L	0.0458333
29	**Potassium (K)**	mg/L	4100	**Copper**	mg/L	0.0184167
30	**Mercury (Hg)**	mg/L	0	**Lead**	mg/L	0.0128571
31	**Silver**	mg/L	0.0198	**Arsenic**	mg/L	0.0338462
32	**Barium**	mg/L	0.1091667	**Total Chlorine**		
33	**Boron**	mg/L	3.6909091			
34	**Cyanide**	mg/L	0.1693333			
35	**Selenium**	mg/L	0			
36	**Phenolic compound**	mg/L	0.3295			
37	**Total Toxic Metals**	mg/L	2.2579167			
38	**Total Chlorine**	mg/L	0.0883333			

Groundwater Analysis:

The values for the groundwater quality analysis are given in Table 1. The results obtained were compared with the WHO standard values. The value of pH was recorded to be within the limits of standard values. A maximum of 8.04 pH was observed that shows a higher alkaline pH of water. Turbidity value was increased

from the standard limits for 76% of the samples with a maximum of 18.9 NTU. Hardness in the samples ranged from 89 mg/L to 388 mg/L, nine out of thirteen samples had a hardness value of above 300mg/L but under the given standard limits. The maximum value of TDS observed was 716 mg/L, lower than the standard value. Chloride content of the groundwater was recorded to range from 19.43 to 51 mg/L and was lower than the standard values given by WHO. Concentration of Boron was recorded to be a highest of 0.2 mg/L and in some samples it was below the detection limit. The value of boron was quite close to the standard value that is 0.3 mg/L. Phenol was one of the parameters exceeding its standard limits. It was observed to the highest of 0.02 mg/L and was ten times higher than the standard limits. The quantity of lead was maximum of 0.022mg/L higher than the standard limits. Nitrate, Nitrogen, Aluminium, antimony, barium, cadmium, cyanide, mercury, nickel, selenium, zinc, manganese, chromium, copper, arsenic, and total chlorine were recorded to be with in the standard limits.

Pearson Coefficient of Correlation between shallow water and leachate-1

Sr. No.	Parameters	Shallow Depth	Leachate	Coefficient of Correlation
1	pH	7.53	8.82	0.982412656
2	TDS	413.3	18889.846	0.982700795
3	Nitrate (NO3), Nitrogen	1.6	26.23	0.999454928
4	Chloride	42	5504.9954	0.9999968
5	Barium	0	0.1091667	0.727706153
6	Boron	0.1	3.6909091	0.72243383
7	Cadmium (Cd)	0	0.063	0.537713395
8	Cyanide	0.003	0.1693333	0.526586493
9	Mercury (Hg)	0	0	0.517905041
10	Nickel (Ni)	0.003	0.3708333	0.497527816
11	Selenium	0	0	0.494510078
12	Phenol	0	0.3295	0.461806862
13	Zinc (Zn)	0.044	3.7730769	0.449395472
14	Manganese (Mn)	0.089	1.5566154	0.869570541
15	Chromium	0.03	0.1153846	0.989609247
16	Copper	0.056	0.2061538	0.990914584
17	Lead	0.013	0.0554615	0.890777869
18	Arsenic	0	0.034375	1
19	Total Chlorine	0.016	0.0883333	0.754275318

The statistical analysis for the Pearson's coefficient of correlation between shallow water and leachate indicate direct means of contamination among the two variables. Among physical parameters pH had a strong correlation of 0.98 between the two variables for sample 1 and 0.97 for sample 2. TDS showed a similar strong correlation with a value of 0.98 for sample 1 and 0.97 for sample 2. Among chemical parameters, Nitrate and Chloride concentrations showed the strongest correlation with a value of 0.99 for both samples except for nitrate in sample 2 which had a strong correlation value of 0.98. Arsenic had the highest correlation of 1for both samples. Chromium and copper had a strong correlation of 0.98 and 0.99 respectively for sample 1 and 0.92 and 0.99 respectively for sample 2.

Pearson Coefficient of Correlation between Shallow water and leachate - Sample 2

Sr. No	Parameters	Observation well water	Leachate	Coefficient of Correlation
1	PH	7.6	8.82	0.970143435
2	TDS	636	18889.846	0.970302351
3	Nitrate (NO3), Nitrogen	5.43	26.23	0.982371955
4	Chloride	28	5504.9954	0.999986417
5	Barium	0.055	0.1091667	0.623377225
6	Boron	0.1	3.6909091	0.658205702
7	Cadmium (Cd)	0	0.063	0.519600348
8	Cyanide	0.007	0.1693333	0.50872972
9	Mercury (Hg)	0	0	0.500908613
10	Nickel (Ni)	0	0.3708333	0.482024679
11	Selenium	0	0	0.477828135
12	Phenol	0	0.3295	0.447215454
13	Zinc (Zn)	0.048	3.7730769	0.430503967
14	Manganese (Mn)	0.14	1.5566154	0.986162635
15	Chromium	0.02	0.1153846	0.90218876
16	Copper	0.041	0.2061538	0.923305879
17	Lead	0.013	0.0554615	0.993885962
18	Arsenic	0.006	0.034375	1
19	Total Chlorine	0.03	0.0883333	0.62517745

A total of 8 parameters were found to have significant or strong positive correlation between the two variables for moderate level depth and leachate. Arsenic had the strongest correlation of 1. Copper, Chloride, and Nitrate had the second strongest correlation of 0.999, 0.993, and 0.992 respectively.

Pearson Coefficient of Correlation between moderate level water and Leachate

Sr. No	Parameters	Moderate level water	Leachate	Coefficient of Correlation
1	pH	7.31	8.82	0.971059796
2	TDS	509	18889.846	0.971280444
3	Nitrate (NO3), Nitrogen	3.2	26.23	0.99215043
4	Chloride	24.4	5504.9954	0.999961506
5	Barium	0.024	0.1091667	0.425016791
6	Boron	0.08	3.6909091	0.418734726
7	Cadmium (Cd)	0.01	0.063	0.405045966
8	Cyanide	0.01	0.1693333	0.393128384
9	Mercury (Hg)	0	0	0.382158346
10	Nickel (Ni)	0.001	0.3708333	0.356621517
11	Selenium	0.001	0	0.348139542
12	Phenol	0.01	0.3295	0.306232112
13	Zinc (Zn)	0.07	3.7730769	0.280324951
14	Manganese (Mn)	0.18	1.5566154	0.745970902
15	Chromium	0.021	0.1153846	0.919157446
16	Copper	0.16	0.2061538	0.993672394
17	Lead	0.01	0.0554615	0.921776373
18	Arsenic	0.01	0.034375	1
19	Total Chlorine	0.05	0.0883333	0.752163480

Pearson's Coefficient of correlation between leachate and deep level water values for physical parameters such as pH and TDS have a strong correlation of 0.97 with leachate. Among the chemical parameters Lead, manganese and Chloride have the strong correlation of 0.99, 0.98, and 0.99 respectively.

Pearson Coefficient of Correlation between Deep level water and Leachate

Sr. No	Parameters	Deep level water	Leachate	Coefficient of Correlation
1	pH	7.52	8.82	0.973672358
2	TDS	366	18889.846	0.974058462
3	Nitrate (NO3), Nitrogen	3.43	26.23	0.988663897
4	Chloride	22	5504.9954	0.999997233
5	Barium	0	0.1091667	0.807402853
6	Boron	0.06	3.6909091	0.805751966
7	Cadmium (Cd)	0	0.063	0.64206515
8	Cyanide	0.004	0.1693333	0.636832703
9	Mercury (Hg)	0	0	0.631664925
10	Nickel (Ni)	0.0016	0.3708333	0.619685553
11	Selenium	0	0	0.637060214
12	Phenol	0	0.3295	0.631581131
13	Zinc (Zn)	0.03	3.7730769	0.728867226
14	Manganese (Mn)	0.034	1.5566154	0.879620681
15	Chromium	0.019	0.1153846	0.759429093
16	Copper	0.02	0.2061538	0.763674022
17	Lead	0.013	0.0554615	0.999922783
18	Arsenic	0.0083	0.034375	1
19	Total Chlorine	0.02	0.0883333	0.635725434

Conclusion:

This review article shows the versatility of techniques that can be used for the assessment of groundwater contamination around landfills. It proves that over the years the techniques have evolved to give an efficient method to deal with the problem of groundwater contamination. Around the world several techniques were used to confirm the leachate contamination in groundwater. The right choice for techniques can vary with the provision of resources and the type of landfill. There is still room for the development of this technique. As the world is progressing more and more towards technologies like using nanoparticles for solving problems – this could also be one dimension towards which this assessment can be carried out.

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IMPACT OF WATERCOURSE LINING ON REDUCING DRAINAGE REQUIREMENTS

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Abstract:

The economy of Pakistan is basically dependent on agriculture. The agriculture presently contributes about 24% to gross domestic product. About 68% of the population settled in rural areas is directly or indirectly involved in agriculture. Water resources development for agriculture has provided a sustainable base for irrigated agriculture. Due to arid to semi arid climate, generally irrigation water supplies are in shortfall. The shortages are partially met through groundwater pumpage through public and private tubewells. The major source of recharge to groundwater is seepage from the canal irrigation system. The economical use of the irrigation supplies necessitates increasing the efficiency of system through conservation measures and better water management.

Based on the data available from review of literature, the seepage losses from unlined main and branch canals varied from 0.03 m/day to 0.58 m/day with an average value of 0.21 m/day (7.99 cfs/msf). It is unfortunate that monitoring of lined canals was very limited or non- existent, therefore, data available for the lined canals located in India and Sri Lanka were also included for analysis. The average seepage losses from lined canals were calculated as 0.12 m/day (4.71 cfs/msf). The comparison of unlined and lined canals shows that on the average 43% of the seepage losses are saved by lining of main and branch canals.

The seepage investigations on unlined distributaries in various projects in Pakistan show an average seepage loss of 0.23 m/day (8.6 cfs/msf) raging from 0.04 m/day to 0.50 m/day. Whereas, the seepage rate of lined distributaries ranged from 0.011 m/day to 0.21 m/day with an average value of 0.10 m/day (3.5 cfs/msf). The figures indicate that on an average 52% of the seepage can be reduced by lining of distributaries.

The field irrigation application efficiency in Pakistan is 70%. With the precision land leveling and grading this can be increased upto 75% since practically with the flooding, 100% application efficiency is impossible. Improved irrigation methods are necessary to be accustomed in areas of severe shortage of irrigation supplies.

On Pakistan basis the length of lined main canal/distributaries and watercourses is 11% and 32% respectively. Based on the data the calculations show that reduction in groundwater recharge would be 0.4 MAF after lining of the remaining watercourses.

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1. Introduction

Agriculture constitutes one of the largest sectors of Pakistan's economy and presently contributes 24 percent to the gross domestic product (GDP). Agricultural exports are 45 percent of the total export earnings and 68 percent people living in the rural areas are directly or indirectly dependent on agriculture. Agriculture absorbs 48 percent of the total labour force. Water resources development for agriculture has provided the base for agricultural production. About 90 percent of agriculture produce depends on irrigated agriculture. The irrigation system of the Indus Basin is one of the largest in world, which diverts annually about 105 MAF of water for crops.

Generally canal supplies in Pakistan are less than the crop water requirements. Normally a flow rate of one cusec is being supplied to irrigate 300 acres in canal-irrigated areas, but it varies from one canal to the other. This is equal to 0.0004 ft/day (1.4 mm/day) at field level assuming conveyance efficiency as 70 percent. Evaporation in Pakistan varies from 0.0006 to 0.0042 ft/day (2 to 14 mm/day) during the year. Crop water requirements are directly proportional to evaporation. This indicates a huge gap between crop water requirement and available canal supplies. Partially the gap is being met by the groundwater abstraction, which has been created by the recharge from irrigation system. The need to use irrigation supplies more efficiently and economically has, therefore, become more essential.

The irrigation application should be precisely matched with the crop water requirements. The amount of excess irrigation water can be minimised, through efficient irrigation methods, appropriate crop selection and better operational management. In case of optimum irrigation practices, any irrigation application surplus can be considered as an intentional recharge source, necessary for the leaching of salts.

In the fresh groundwater zones the canal seepage water is captured and reused for irrigation by the tubewell pumping in these zones. The farmers have installed over 7 lac tubewells all over the country. The tubewell pumpage is comparatively less in saline groundwater areas and seepage can cause waterlogging and salinization. The deficit canal supplies have resulted in over exploitation of groundwater.

Considering the size of main and branch canals, lining of existing channels is neither practicable, nor feasible. However, lining of main and branch canals can be done at the time of initial construction. Therefore, options left are distributary and watercourse lining. During the past three decades watercourse lining was continued and also has been planned for future. Punjab and some other provinces have also associated programmes like precision land leveling and watercourse reconstruction (earthen improvement with provision of control structures). Collectively these programs are referred as 'watercourse lining plus' measures.

2. MATERIAL AND METHODS

2.1 Canal System

Surface water stored in reservoirs or diverted directly is distributed for irrigation through canal irrigation system. A canal originates from a head regulator of a barrage or water storage dam. Irrigation water flows through a complete chain of canal system before it reaches to a farmer field for irrigation. The canal system chain

consists of main canal, branch canal, distributary, minor, watercourse and field channels, which are termed according to their capacity and orientation with respect to the headworks. In Pakistan, the canals and branches upto minor distributaries, and the outlets are constructed, operated and maintained by the government.

Between the point of diversion of canal and the farmer's field, a substantial amount of water transmitted through unlined canal system is lost in transit. These losses include evaporation from water surface varying from 2 to 14 mm/day, depending upon climatic conditions, seepage from bed and sides of the channels, evapotranspiration of the vegetation along canals and unauthorized spill over. The degree of these losses varies within wide limits depending upon the following principal factors:

(i) Characteristics of the soils and region through which the channel passes.

(ii) Channel section, wetted perimeter and water depth

(iii) Velocity of flow in the channel

(iv) Depth to groundwater table, and

(v) Sediments in the water.

The seepage losses are 15 percent in main and branch canals, 8 percent in distributaries and minors, 30 percent in watercourses and 30 percent water lost during field application (GOP, 2005).

2.2 Water Conservation by Lining

The water losses through seepage and deep percolation are at different level depending on stage and discharge of the channel. The water saved by lining plus measures would be of different degrees depending upon the lining material, thickness of lining, impervious layer and methods of improved irrigation practices. The quantity of water conserved at each stage of the irrigation system is discussed in the following paragraphs.

2.2.1 Water Saved by Lining of Main and Branch Canals

(i) Unlined Canals

Based on the data available from review of literature the seepage losses from unlined canals, the seepage rate varies from 0.03 m/day to 0.58 m/day. On the basis of available data the average seepage loss from unlined canals has been calculated as 0.21 m/day (7.99 cfs/msf).

(ii) Lined Canals

Unfortunately monitoring of the lining was very limited or non-existant. As a result post-lining data of lined canals in Pakistan is not sufficiently available. Therefore, data available for the lined canals located in India and Sri Lanka have been included for analysis. The summary of seepage losses from lined canals located in the various parts of Indo-Pak subcontinent and Sri Lanka. The average seepage loss from lined canals has been calculated as 0.12 m/day (4.71 cfs/msf). The comparison of average seepage rate of lined and unlined canals shows that on the average only 43 percent of seepage losses are saved by lining of main and branch canals.

2.2.2 Water Saved by Lining of Distributaries

(i) Unlined Distributaries

The seepage investigations on unlined distributaries in various projects in Pakistan are available from the studies conducted in the past. The seepage losses reported for different distributaries are given in Table 3.3. Seepage rate varied from 0.04 m/day to 0.50 m/day. On the basis of available data the average seepage loss from unlined distributaries has been calculated as 0.23 m/day (8.6 cfs/msf).

Table 2.1: Summary of Seepage Losses from Unlined Distributaries and Minors

Distributary	Seepage Loss		Reference
	m/day	cfs/msf	
Mudki Disty.	0.30	11.39	Goldsmith and Makin, 1989
James Disty.	0.04	1.43	ISRIP, 1996
Muktsar Disty.	0.50	18.98	Paul and Dhillon, 1989
Lagar Disty. (U G.Br.)	0.15	5.69	Bhutta, 1990
FESS distributaries	0.07	2.73	Bodla et al., 1998
Chabba Disty.	0.30	11.39	Cheena and Piracha, 1993
Average	**0.23**	**8.6**	
Maximum	**0.50**	**18.98**	
Minimum	**0.04**	**1.43**	

Table 2.2 gives the seepage rate of lined distributaries and minors. Average seepage rate of lined distributaries is 0.10 m/day (3.5 cfs/msf). However, the seepage rate varied from 0.011 m/day for FESS distributaries, to 0.21 m/day for Niaz Beg distributary. The variation is due to material and quality of lining.

The data suggest that on an average 52% of the seepage (0.12 m/day) can be reduced by lining of distributaries and minors.

Table 2.2: Summary of Seepage Losses from Lined Distributaries and Minors

Distributary	Seepage Loss		Reference
	m/day	cfs/msf	
Niazbeg Disty.	0.21	7.97	Haider and Maclung, 1989
Shahkot Disty.	0.026	0.99	Haider and Maclung, 1989
Pakpattan Canal System	0.14	5.31	Haider and Maclung, 1989
6R Hakra System	0.16	6.07	Haider and Maclung, 1989
Sunam sub-branch	0.058	0.20	Paul and Dhillon, 1989
FESS distributaries	0.011	0.43	Khan and Ahmed, 2001
Average	**0.10**	**3.495**	
Maximum	**0.21**	**7.97**	
Minimum	**0.011**	**0.43**	

2.2.3 Losses Reduced by Watercourses Lining

A watercouorse consists of two parts: i) Sarkari watercourse and ii) Farmers watercourse. Although the total length of farmer watercourse is many time longer than Sarkari watercourse but water remains more time in the Sarkari watercourse. As discussed in chapter 2 the ratio of conveyance losses between Sarkari and farmers's watercourse is 57 and 43 percent. Total conveyance losses along a watercourse are 30 percent of the discharge at the head of watercourse. This means losses in Sarkari watercourse are 18 percent and 12 percent in farmer's watercourse.

As the conveyance losses in entire length of Sarkari watercourse are 18, its 15 percent length will have 3 percent losses and 30 percent length will have 6 percent losses.

If we assume that 70 percent of losses are reduced due to lining, lining 15 percent length of Sarkari Khal will 2 percent (3 percent × 70 percent) of losses along the watercourse. Similarly lining 30 percent of the length will reduce 4 percent (6 percent × 70 percent) of losses along water courses.

2.2.4 Reduction in Deep Percolation with Land Leveling and Improved Irrigation Practices

On an average, field application efficiency in Pakistan is 70% and 30% is deep percolation. With precision land leveling and grading, application efficiency can be increased to 80 percent. Practically, with traditional surface irrigation system, 100 percent application efficiency can not be achieved unless crops are under irrigated which will other wise affect the yields.

3. Lining and Water Management Projects

The primary objective of lining is to reduce conveyance losses of irrigation system. The complementary benefits of lining are to increase carrying capacity of canal, prevention of failure of canal and reduction in operation and maintenance cost. The lining also adds in aesthetic value of the countryside. A view of lined distributary in Punjab is shown in Figure 3.1. Lining under the water management projects reduced the conveyance losses of watercourses and deep percolation from the irrigated fields.

Figure 3.1: A View of a Distributary Lined in Punjab under CWMP.



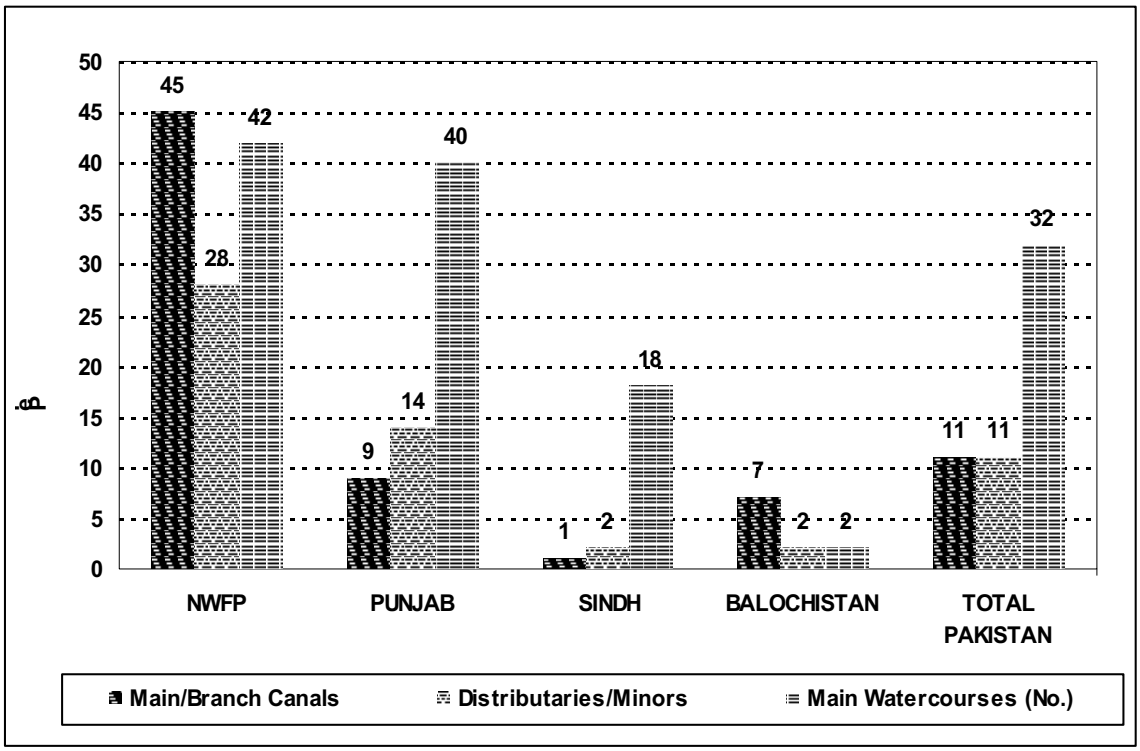
3.1 Completed Projects

3.1.1 Lining of Main/Branch Canals, Distributaries and Minors

Before independence, the first canal lined was Bikaner off-taking from Ferozepur Barrage now in the India. About 84 miles length of the canal was lined in 1924. Haveli was the second lined canal off-taking from Trimmu Barrage. It was lined in 1937. The problems, which, appeared on this lined canal were discussed during 1942 by S.N.Kapur. Ever since then Pakistan continued to line its canals such as Thal Main Line Upper and Lower and Mohajir Branch during 1944 to 1950, Akram Wah (lined channel) in 1951-57, Bambanwala-Ravi-Bedian-Depalpur Link in 1953, Balloki-Sulemanki Link in 1955, Sindhnai-Mailsi-Bahawal Link in 1965, Chashma Right Bank Canal (CRBC) Stage-I in 1986-87, CRBC Stage-II in 1988-1992, CRBC Stage III in 1993-2003, Warsak Gravity Canal, Warsak Lift Canal during 1985-1992, Lasbela canals in 1982 and few other minor canals, mostly using layers of bricks or cement concrete. Lasbela canal is a lined channel off taking from Hub Dam. The canal was commissioned in 1982. All of its minors except minor No.9 and 75 percent of the total watercourses are concrete lined. The gross area of the Lasbela command is 34,000 acre and CCA as 18566 acre.

For the last 58 years the performance evaluation of the existing lined canals, with respect to the objectives of canal lining, has never been taken up seriously. In the past lining of small distributaries and minors has been undertaken under various projects like Command Water Management Project (CWMP), FESS, SCARP VI, Khushab SCARP and National Drainage Programme (NDP). Status of province-wise canal lining is discussed in the following sections.

Figure 3.2: Province Wise Status of Main/Branch Canals, Distributaries and Watercourses Lined under various Projects in Pakistan.



3.1.2 Lining of Watercourses

In the past watercourse lining was carried out under On Farm Water Management Programme (OFWM) in all the four provinces of Pakistan. In the beginning, the entire watercourse was lined on experimental basis but for implementation an optimum length 15 percent of Sarkari Khal in fresh groundwater areas and 30 percent of the Sarkari Khal in saline groundwater areas had been lined. Pacca control structures were being provided on the entire length of Sarkari Khal.The statistics of lined and unlined watercourses in NWFP, Punjab, Sindh and Balochistan in fresh and saline groundwater zones are given in Table 3.1.

Table 3.1: Statistics of Lined Watercourses in the four Provinces of Pakistan

Province	Lined Watercourses (No)			Unlined Watercourses (No)			Total (No)		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
NWFP	8500	0	8500	11900	0	11900	20400	0	20400
Punjab	7715	15256	22971	15479	19660	35139	23194	34916	58110
Sindh	2491	5004	7495	14423	20396	34819	16914	25400	42314
Balochistan	29		29	812	603	1415	841	603	*1444
Total (Pakistan)	**18735**	**20260**	**38995**	**42614**	**40659**	**83273**	**61349**	**60919**	**122268**

* About 12,000 watercourses which are out of Indus Basin System in Balochistan Province are not included.

Source: OFWM (2003).

3.1.3 New Canal Lining Projects

(i) Greater Thal Flood Canal (GTFC)

For the construction of Greater Thal Flood Canal, a head regulator of 8500 cfs discharge capacity was provided on the right bank of Chashma Jhelum Link Canal at RD 180+222 near Adhikot town. The work on construction of canal was started in May 2002. The length of 35 km of main canal alongwith 42 km branch canals and 1835 km of distributaries and minors will be constructed and lined. The gross 2.27 Mac and culturable command area is 1.85 Mac. The canal will irrigate newly developed lands of districts of Bhakkar, Leiah, Khushab and Jhang of the Punjab province.

(ii) Rainee Canal (RC)

The Rainee Canal Project is situated on the eastern side of Sukkur district adjoining the command area of Ghotki Feeder commonly known as Rainee Desert. The construction of this lined canal has been initiated. Rainee Canal off takes from left side of Guddu Barrage on Indus River. Its design discharge is 5155 cfs. The total length of canal is 154 km. Before entering into its command area, the canal has a blind length to 54 km. The canal will serve a culturable command area of 412,400 ac. The total length of proposed lined main canal is 154 km (Table 3.2). The length of distributaries and minor will be 609 km.

(iii) Kachhi Canal (KC)

Kachhi Canal is an independent lined canal offtaking from Taunsa barrage. It is being constructed with a discharge capacity of 6000 cfs. The canal would run

parallel to D.G. Khan Canal. The system has 500 km lined main canal with 2000 km of lined distributaries and minors (Table 4.12). As the area couldn't be commanded through Pat Feeder Canal this canal would also run parallel to Pat Feeder but at a higher elevation. The canal will be constructed at a cost of Rs.28 billions (WAPDA, 2003). The command area served will be in Balochistan province.

(iv) Mirani Dam

Left Bank Canal and Right Bank Canal of Mirani Dam Project are being constructed and lined. These are expected to be completed in the year 2006-07. The length of left and right bank canal is 39 km. The length of distributaries and minors is 88 km.

(v) Chashma Right Bank Canal (CRBC)

The construction of about 666 km of partially lined and unlined distributaries and minors in Chashma Right Bank Canal command (NWFP) is in progress.

(vi) National Drainage Programme (NDP)

Total length of distributaries and minors being lined in Punjab is 191 km by PID under National Drainage Programme (Table 3.2).

Table 3.2: New Canal Lining Projects

(km)

Project	Main/Branch Canal	Distributaries / Minors	Total
Greater Thal Flood Canal (GTFC)	77	1835	1913
Rainee Canal (RC)	154	609	763
Kachhi Canal (KC)	500	2000	2500
Mirani Dam	39	88	127
Chashma Right Bank Canal (CRBC)	0	666	666
National Drainage Programme (NDP)	0	191	191
Punjab Distributaries Lining	0	13310	13310
Sindh Distributaries Lining	0		
NWFP Distributaries Lining	0		
Total	770	18699	19470

4. Results and Discussion

Water balance for the Indus Basin is given in Table 4.1. Annual volume of available water is given at head of canals, distributaries and watercourses. Seepage is calculated as percentage of volume at head. Percent seepage values are average values used in the Indus Basin. Recharge is calculated from the seepage volume. Percent recharge values are taken from WAPDA planning documents. Based on these values the recharge volume is calculated for canals, distributaries, watercourse and field. Recharge component of tubewells and rainfall is also calculated and added. Table 4.1 indicates that total aquifer recharge is 66.8 MAF. In Table 4.1 if the seepage rate is reduced, it will reduce the recharge and water reaching at head of the next location will be increased.

Table 4.1: Water Balance of the Indus Basin

Location	Present Situation				
	At Head MAF	Seepage		Recharge	
		Percent	MAF	Percent	MAF
(i) Canal Diversions					
Canals	105.0	15.0	15.8	75.0	11.8
Distributaries	89.3	8.0	7.1	75.0	5.4
Watercourses (Sarkari)	82.1	17.3	14.2	60.0	8.5
Watercourses (Farmers)	67.9	12.0	8.1	60.0	4.9
Fields	59.8	30.0	17.9	90.0	16.1
Crop Use	41.8				
(ii) Tubewells					
Watercourses (Farmers)	50.0	10.0	5.0	60.0	3.0
Fields	45.0	25.0	11.3	90.0	10.1
Crop use	33.8				
(iii) Rainfall					7.0
Total					66.8

4.1 Seepage Reduction in Main and Branch Canals due to Lining

Table 2.2 indicates an average seepage rate of 0.21 m/day from unlined canals and 0.12 m/day from lined canals. This shows reduction in seepage rate of 0.09 m/day which means 43 percent of existing seepage. In addition 10 percent of seepage will be reduced due to reduction in wetted perimenter. This means seepage from main and branch canals can be reduced about 53 percent by proper lining. At present seepage from main and branch canal is 15 percent (Table 4.1). This can be reduced to 7 percent (15 percent – 15 percent × 53 percent) after lining. But practically lining of existing unlined canals is almost impossible. Because, for lining period an alternate canal will be required and for such long period existing agriculture will extremely suffer. Therefore no existing main and branch canal is being lined in the country. However, all the new canals are being constructed with lining. Therefore, seepage from new canals will be less than old earthen canals.

In existing canals, NWFP has the highest ratio of length of lining. Lined length of main and branch canals in NWFP is 45 percent, in Punjab 9 percent and Sindh has only one percent. Balochistan has seven percent lined length of main and branch canals whereas on Pakistan basis it is 11 percent.

4.2 Seepage Reduction in Distributaries due to Lining

Table 2.2 indicates an average seepage rate of 0.22 m/day from unlined distributaries and 0.10 m/day from lined distributaries. This shows a reduction in seepage rate of 0.12 m/day by lining which is equal to 52 percent of existing seepage. In addition 10 percent of seepage will be reduced due to reduction in wetted perimenter by lining. This is only possible if the lining is of high quality. This means seepage from distributaries and minors can be redeuced about 62 percent by

lining. At present seepage from distributaries is 8 percent (Table 4.1). Therefore, it can be reduced to 3 percent (8 percent – 8×0.62 percent) after lining.

Lining of distributaries is on-going in the country under different projects depending upon resources available. Details of on-going projects are given in Chapter 4. However, life of lining is not known as very little work has been carried out for this purpose.

There is some problem of sedimentation in the lined distributaries which adversely affects the discharge capacity of distributaries. Performance monitoring of lined distributaries and minors has been neglected. As a result very little can be learnt from previous experience of lining in the country.

4.3 Seepage Reduction in Watercourses due to Lining

As the conveyance losses in entire length of Sarkari watercourse are 18 percent. In fresh groundwater areas only 15 percent length of Sarkari Khal is being lined. Therefore, its 15 percent length will have 3 percent losses and 30 percent length will have 6 percent losses.

If 70 percent of losses of the lined length are reduced due to lining, the lining of 15 percent length of Sarkari Khal will reduce 2 percent (3×0.70 percent) of losses along the watercourse. Therefore, after lining of 15 percent length of Sarkari watercourse, losses in Sarkari watercourse will be reduced to 16 percent (18 percent-2 percent). Similarly lining 30 percent length of Sarkari watercourse will reduce 4 percent (6×0.70 percent) of losses along water courses. Therefore after lining 30 percent length of Sarkari watercourse, the losses in Sarkari watercourse will be reduced from 18 to 14 percent (18 percent – 4 percent).

As total of 38995 number of watercourses in the Indus Basin have already been lined. The remaining 83273 watercourses are targeted for lining under National Programme for Improvement of Watercourses in Pakistan (WPIWP). Out of which 42614 watercourses are in fresh groundwater zone and 40659 watercourses are in saline groundwater zone. Using the above values of reduction seepage has been calculated assuming lining of 15 percent and 30 length of Sarkari watercourse.

The lining of 15 percent length of 42614 watercourses in the fresh groundwater zone and 30 percent length of 40659 watercourses in saline groundwater zone, the recharge to groundwater aquifer will be 66.4 MAF. Under present conditions recharge to aquifer is 66.8 MAF. The reduction in groundwater recharge will be only 0.4 MAF due to watercourse lining but one MAF of additional water will be available for crop use.

4.4 Reduction Deep Percolation due to Precision Land Levelling and Grading

Under present conditions surface water reaching the fields is 59.7 MAF and 61.2 MAF after lining of all the remaining watercourses. Deep percolation from fields is 17.9 MAF under existing conditions and 18.35 MAF after lining of all the remaining watercourses. Similarly recharge is 16.1 MAF under existing conditions and 16.5 MAF after lining of all the watercourse. This shows that after lining of watercourses more water will be reaching in the fields and 0.4 MAF of water will additionally saved from deep percolation.

By field smoothing and grading field application efficiency can be increased from 70 percent to 75 percent. This can help to reduce deep percolation from 17.9 MAF to 14.9 MAF. This additional 3 MAF will be available for crops use.

However the pace of field smoothing and grading is very slow. More additional water can be made available for crop use by adopting efficient irrigation methods.

4.5 Reduction in Drainage Requirement due to Watercourse Lining and Land Levelling

As the reduction of aquifer recharge due to lining of all the remaining watercourses will be only 0.4 MAF. Therefore, impact of watercourse lining on reducing drainage requirement will be very nominal. However, there are additional significant benefits of watercourse lining.

5. Conclusions and Recommendations

Based on the review of past studies related to lining, documentation of completed projects and analysis of data, the following conclusions and recommendations are being made:

5.1 Conclusions

The conclusions are categorized as lining effectiveness on seepage control, achievements and reduction of drainage requirements. The conclusions for each set of the irrigation system are as under:

5.1.1 Lining Effectiveness

The conclusions related to effectiveness of lining on reducing seepage for canals, distributaries and watercourses are given in this section.

(a) Main and Branch Canals

Review of literature and available data indicate that average seepage for unlined canals is 0.21 m/day (7.97 cfs/msf). Unfortunately available monitoring data of lined canals is limited due to lack of interest in performance monitoring. Based on the available data of lined canals, the average seepage rate has been calculated as 0.12 m/day (4.71 cfs/msf).

This shows that lining of main canals can reduce seepage rate of 0.09 m/d which is equal to 43 percent of the existing seepage.

(b) Distributaries and Minors

The seepage investigation on unlined distributaries indicates an average seepage rate of 0.23 m/day (8.6 cfs/msf). The average seepage rate of lined distributaries and minors has been estimated as 0.10 m/day (3.5 cfs/msf). This shows that lining of distributaries and minors can reduce 52 percent of the existing seepage.

(c) Watercourses

The field investigations show that average seepage/conveyance losses from watercourses are 30 percent. Out of which 18 percent are from Sarkari watercourse and 12 percent from farmer watercourse.

Lining of 15 percent length of Sarkari watercourse can reduce two percent of seepage/conveyance losses. Therefore after lining 15 percent length of Sarkari watercourse, the losses in Sarkari watercourse will reduce from 18 percent to 16 percent.

Similarly lining of 30 percent length of Sarkari watercourse can reduce four percent of seepage/conveyance losses. Therefore, the lining 30 percent length of Sarkari watercourse, the losses in Sarkari watercourse will reduce from 18 to 14 percent.

5.1.2 Lining Achievements

The upto date status of completed lining of main/branch canal, distributaries/minors and watercourses is summarized in Table 5.1

Table 5.1: Completed Lining of Main/Branch Canals Distributaries and Watercourses

(Percent of Total Length)

Province	Main/Branch Canals	Distributaries/Minors	Overall Length	Watercourses
NWFP	45	28	34	42
Punjab	9	14	13	40
Sindh	1	2	2	18
Balochistan	7	2	3	2
Pakistan	11	16	14	32

Watercourses have been lined under different projects in the country. The lining is only done for Sarkari watercourse. The length of lining of Sarkari watercourse depends upon the groundwater quality. For fresh groundwater area only 15 percent of the length is lined and for brackish groundwater areas 30 percent of the length is lined. Province wise summary of number of lined watercourses are given in Table 5.2. Total lined watercourses in Pakistan are 32 percent. But the overall length of lined watercourses is only 15 and 20 percent in fresh and saline groundwater zones respectively.

Table 5.2: Completed Lining of Watercourses

(Percent)

Province	Fresh Groundwater		Saline Groundwater		Total	
	Lined	Unlined	Lined	Unlined	Lined	Unlined
NWFP	42	58	0	0	42	58
Punjab	13	27	26	34	39	61
Sindh	6	34	12	48	18	82
Balochistan	2	56	0	42	2	98
Pakistan	15	35	17	33	32	68

5.1.3 Reduction in Drainage Requirement

Based on the data and analysis given in Chapter 4, it is evident that reduction in groundwater recharge will be 0.4 MAF by lining all the remaining distributaries and watercourses. A more significant impact can be achieved by improving field application efficiencies. But actual progress in this regard is a modest one.

5.2 Recommendations

i) Management of main canals needs to be improved. Farmers have to be given increased role in management to improve the equity of water distribution.

ii) Due consideration should be given to quality control of lining for distributaries and minors. Involvement of farmers' organization can help a lot.

iii) Length of lining of Sarkari Khal should be increased from 15 and 30 percent to 50 percent to have significant impact on reducing seepage and drainage requirements.

iv) Improved irrigation methods should be adopted to make better use of available water. It will also help reduce recharge/drainage requirements.

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THE ADAPTABLE SUPPORT PATTERNS USING INFORMATION TECHNOLOGY FOR REDUCING UNEMPLOYMENT IN DIFFERENT ENGINEERING SECTORS OF PAKISTAN

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ABSTRACT

The Islamic Republic of Pakistan is considered as a developing country in the world, which is facing numerous problems i.e. financial constraints, improper management of reserves, unemployment, minimum support from private sector/business community, etc. No matter how many issues someone has, the gigantic problems demand to manage them with proper methods and policies. The current unemployment rate in Pakistan is 5.79 % [1]. More than 50,000 engineers are unemployed out of 2,56,423 engineers [2]. Information Technology involvement enables the business of every sector of life, more convenient, economical and profitable. The engineering sectors can show productive results by using online systems relevant to their needs. The engineering companies or firms can be operated without huge investments, they can save funds of managerial, finance and record division staff with some online systems. Under one pattern, an online system is suggested and thoroughly discussed which is named “Agricultural Machineries and Technical Support Rent out Management System (AMTSRMS)”, can be used by agriculture engineers to provide rental services of agricultural machinery as well as for technical assistance. The survey conducted for this specific online system shows that Agri. Engineer will earn more than the salary of a Govt. official of grade 17 even on his earlier stages and a team of 80 workers will work for him. More than 1095 Agri. Engineers can settle their businesses on one-third of the total cropped area (16.61 million hectares) [5] of the Punjab province. Similarly, the Civil engineering sector will require different online system for a specific task with some online and offline activities options, maybe called Civil Engineering Software package, etc. The introduction of Information Technology in such a manner is really effective and considerable to enhance productivity with cost efficiency and less burden of work. The unemployment and business challenge is recoverable by encouraging retired, engineering field experienced professionals with the settlement of businesses using adaptable support patterns provided by IT field.

Key words: Reducing un-employment, Information Technology, Online Management Systems

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1. INTRODUCTION

Every country's strong economic condition shows the stability in every sector of life, especially in private sector. Pakistan has great potential in engineering sector if it is well managed at country level. Every year thousands of engineering students complete their education but a few of them get proper jobs and some of them getting improper jobs in both Government and Private sector. A major proportion of the educated students moves abroad in search of jobs (Sometimes they get relevant and mostly getting irrelevant jobs).

1.1 Unemployment

The unemployment rate is defined as the percentage of unemployed workers in the total labor force. Workers are considered unemployed, if they currently do not work, despite the fact that they are able and willing to do so. The total labor force consists of all employed and unemployed people within an economy. The unemployment rate provides insights into the economy's spare capacity and unused resources. Unemployment tends to be cyclical and decreases when the economy expands as companies employ more workers to meet growing demand. Unemployment usually increases as economic activity slows.

1.1.1 Types of Unemployment

1. **Frictional unemployment:** Frictional unemployment refers to temporary unemployment during the period when people are searching for a job.
2. **Structural unemployment:** Structural unemployment is a mismatch between workers' skills or locations and job requirements.
3. **Seasonal unemployment:** Seasonal unemployment is caused by seasonal patterns in economic activity, such as harvesting or tourism.

The methodology for calculating the unemployment rate often varies among countries since different definitions of employment and unemployment, as well as different data sources, are used.

1.2 Pakistan's Unemployment Rate

Pakistan's Unemployment Rate was 5.79 % in June 2018. Pakistan's Unemployment Rate is updated yearly, available from June 1980 to June 2018, with an average rate of 5.55 %. The data reached an all-time high of 8.27 % in June 2003 and a record low of 3.04 % in June 1986. The data is reported by the Pakistan Bureau of Statistics.

In the latest reports, Pakistan's Population reached 207.77 million people in June 2017.

Table-1 shows the unemployment rate generated by the Pakistan Bureau of Statistics [4].

Table 1: Unemployment rate generated by Pakistan Bureau of Statistics

Last	Previous	Min	Max	Unit	Frequency
5.79 Year 2018	5.94 Year 2017	3.04 Year 1986	8.27 Year 2003	%	Yearly

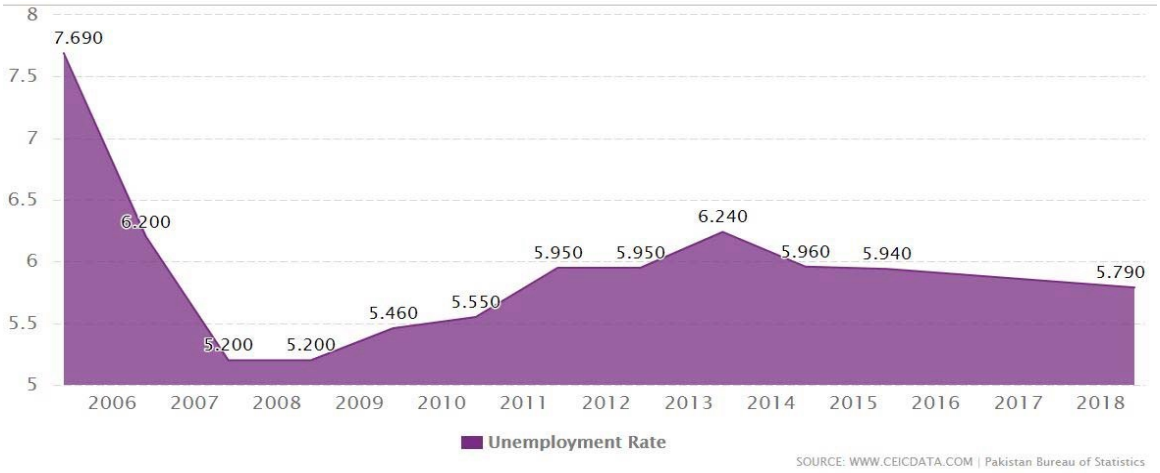


Figure 1: Unemployment Rate of Pakistan in different years

The total registered engineers with PEC (Pakistan Engineering Council) are 2,56,423, thirty percent of them (77,000) working abroad, 50,000 are unemployed and remaining are serving the country at different levels.

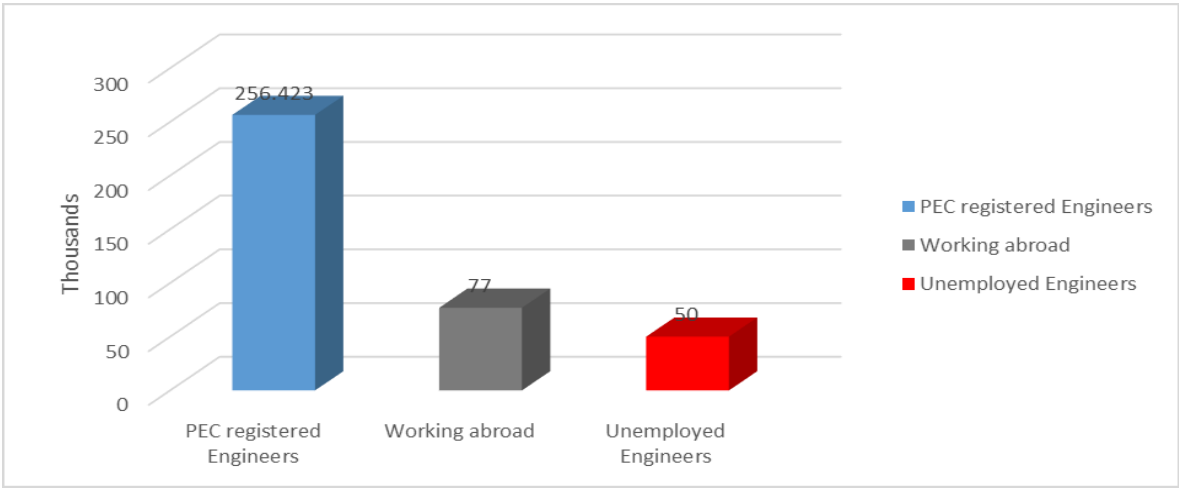


Figure 2: Registered engineers with PEC (Pakistan Engineering Council), working abroad and still unemployed.

2. Adaptable Patterns using Information Technology for reducing unemployment

The following three patterns of information technology can be adopted in Pakistan to reduce unemployment rate in engineering sectors.

2.1 PATTERN 1: Engineering Tasks through online system (Pakistan based)

Departments/Firms/Institutes can launch assignment tasks through such online portals. Tasks through online systems based on Pakistan will be secure. The tasks can be discussed in detail in the native language and performance will be outstanding as highly skilled engineers will be available to offer their services at low costs. An engaged employee of some firm/institute can also offer his assignment task-based services on part time.

A firm/institute can start its business without a huge capital investment. No problem who skips or get rid of such works on some time because payments will be scheduled through online system, it will not affect or harm someone with the skippers.

Examples of engineering tasks

1. Software Based Assignments (Auto-Cad, Proteus, PLC) etc.
2. Report Writing
3. Report Review
4. Final Report

The benefits are as follows;

1. Hiring of professionals for long time creates burden on the institutes/firms, the assignment tasks approach through bids removes this effect.
2. The assignment tasks approach is useful for the engineers and the supporting staff, resident on distant places.
3. It is much economical for small institutes or firms.
4. Easier to manage without managerial, finance and record staff.
5. Convenient to get access to anything at any place and time.
6. It will also make easier to hire relevant willing engineer for even offices, if required.

2.2 PATTERN 2: Development of Specific Tasks Performing Engineering Online Systems

The engineering field works can be managed through online systems, the only requirement is to find an approach towards capacity declaration of sub-field of some engineering field. If some engineering field has its sub-field to move forward properly with the involvement of Information Technology, then it is necessary to get some online management system according to the requirements.

2.2.1 Approach towards capacity declaration of sub-field of some Engineering field

The capacity declaration is necessary before introducing Information Technology in some engineering field. The calculations should be done by conducting research studies or by literature review.

The following questions should be answered clearly.

1. Which sub-field of an engineering field can be responsive to online software packages?
2. How many Engineers of that field and supporting staff will be involved?
3. How much profit the institute or firm, if created, will generate?
4. How much benefit will be added to the people of Pakistan?
5. For how much time it will be benefited?
6. Recommendations for setting-up an institute / firm in public or private mode.

2.2.2 Benefits

1. Hiring of engineering professionals for the institutes/firms.
2. It is much economical for individuals who want to setup a business.
3. Easier to manage without managerial, finance and record staff through some specific online system.
4. Convenient to get access to anything at any place and time.
5. Easier to instruct staff through this.

Such type of online systems are recommended, so the worth of an existing successful system should be discussed for an example over here, which is Uber, it involved almost 80,000 drivers since it introduced in Pakistan.

2.2.3 Example of capacity declaration

Pakistan is an agricultural country and a major proportion of its economy depends on agriculture. In agriculture there are many options where online systems can be used for mechanized farming (Productivity enhancement, convenient communication, services on doorstep etc.)

An online system's capacity (Agricultural Machineries and Technical Support Rent-out Management System) was estimated by the students of University of Gujrat (Lahore Campus). This was related to agricultural engineering and the mechanized approach through online system shows positive results which are discussed in detail as below;

2.2.3.1 Working area declaration

Punjab has total cropped area of 16.61 million hectares [5] which is equivalent to 41.04 million acres. It is assumed that one village has 625 acres, according to this Punjab will have 65,671 villages. The assumption of one working unit is of 20 villages. The total working units in Punjab, according to this assumption are 3,284 and with 1/3rd approach the units are 1095.

Table 2: Chart of working area distribution

One Village (Acres)	One Unit (Villages)	Villages in Punjab (Total Acres/625)	Units Available in Punjab (Villages in Punjab/20)	Units through 1/3 approach
625	20	65671	3284	1095

1/3rd Approach

It is assumed that there are three types of landlords in 625 acres having equal proportions.

First type: This belongs to elite class which has its own machinery and equipment for field works and this type will not use any online system for their works.

Second Type: This belongs to middle or lower class which do not own machinery and equipment but this class doesn't want to follow such system.

Third Type: This type also belongs to a middle or lower class which do not own machinery but agree to use online system for their fieldworks. As it has an equal proportion so this type will hold 208 acres. In survey findings, it is cleared that an

acre requires at least three times plough for sowing the crops. So the total area available in a village to plough through online system is almost 625 acres.

2.2.3.2 Financial estimations

The survey results show that machinery owner is agreed to give off averagely 12.5 % to Agri. Engineer/services provider in order to gain more orders per day. For the automation it is necessary to distribute this percentage into different stakeholders to run a smooth business without any difficulty. The owner of the machinery will get 87.5%, services provider/Agri. Engineer will get 9%, order takers (Shopkeepers of that village) will get 2.5% and IT experts will get only 1% of the total amount.

Table 3: Benefits gained percentage among the people involved

Machinery Holder (%)	Service Provider (%)	Order Taker or Shopkeeper (%)	System Generator's/IT Supporting Team (%)
87.5	9	2.5	1

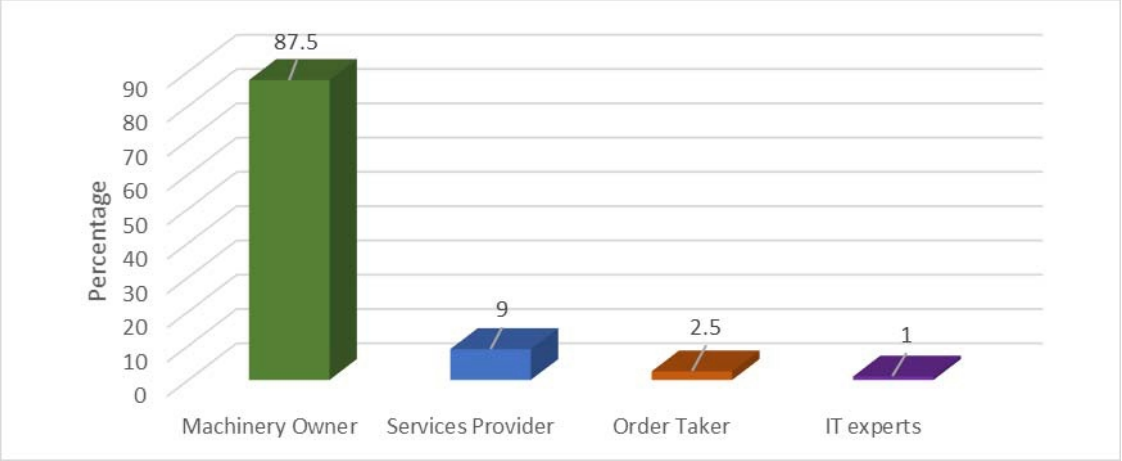


Figure 3: Benefits gained percentage among the people involved

The survey was conducted in the surrounding villages of Lahore and Faisalabad cities. Per acre rate in both areas for land plowing was 800 Rs/acre. According to the percentage scenarios payment/acre to machinery holder will be Rs.700, Services Provider/Agri. Engineer Rs.72, order taker (Shopkeeper) Rs.20 and to IT team will be Rs.8.

Table 4: Detail of per acre payments to different stakeholders

Per Acre Demand (RS)	Payment to Machinery Holder 87.5 % in (RS)	Payment to Machinery Provider 9 % in (RS)	Payment to Order Taker (Shopkeeper) 2.5 % in (RS)	System Generator's/ IT Supporting Team 1 % in (RS)
800	700	72	20	8

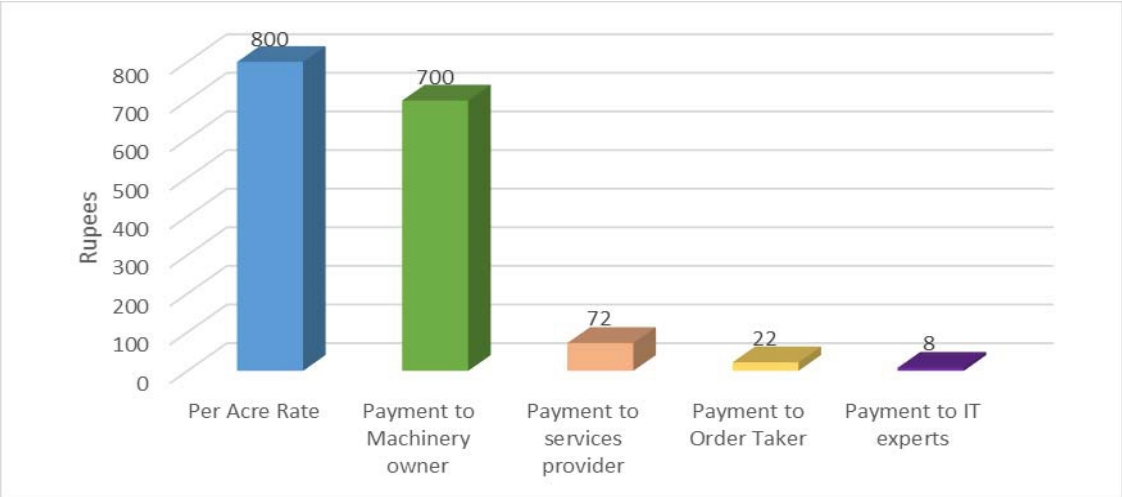


Figure 4: Benefits gained percentage among the people involved

2.2.3.3 Machinery holder's Orders Estimations

A machinery holder can work for only eight hours in a day, the average time to plough a field was 45 minutes, maximum of 11 orders by a machinery holder can be entertained, a day. The total expected area to plough is 625 acres, so there is dire need to contract with two machinery providers in one village area, then they will also be able to cover more areas in case of increased demand.

Table 5: Machinery holder's Orders Estimations

A day		Plough Time/acre (Minutes)	Total Orders/day	Maximum Orders/month
Hours	Minutes			
8	480	45	11	330

2.2.3.4 Agri. Engineer's Profit

The Agri. Engineer will earn 72 Rs/acre and from one village he will earn Rs.44, 928. As he will manage at least one unit (20 Villages) and one unit's seasonal profit will be Rs.899,000 (Eight hundred ninety nine thousand rupees). He will earn at least double of the newly appointed officer of BPS-17. The comparison charts of seasonal profit vs. per month profit, income of Agri. Engineer/Services Provider vs. Govt. official of BPS-17 and Agri. Engineers' employment out of total unemployed engineers is listed below.



Figure 5: Agri. Engineer seasonal profit vs. per month profit

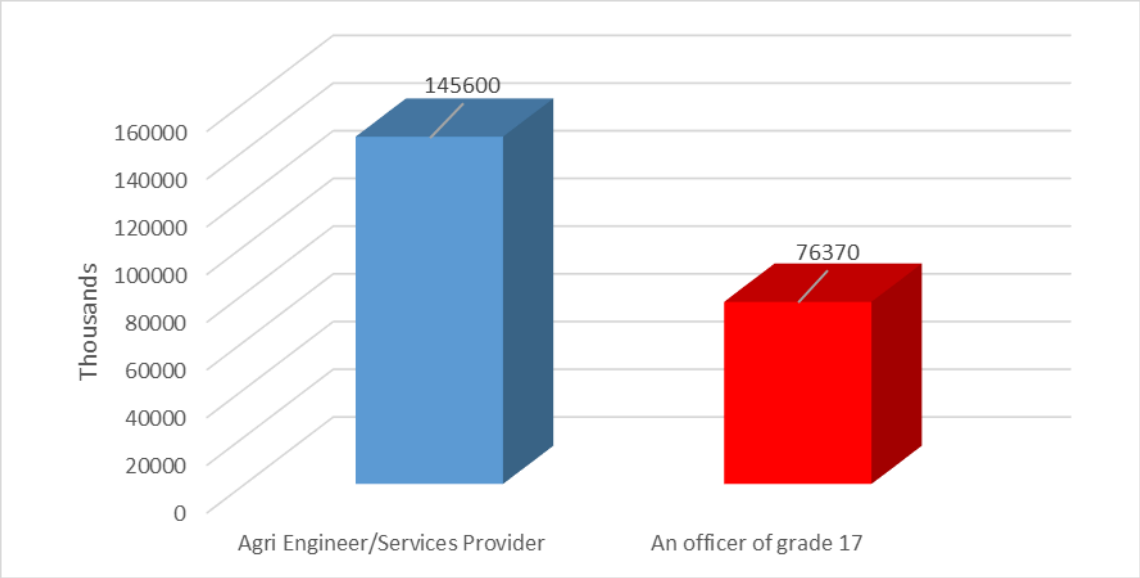


Figure 6: Comparison between Agri. Engineer/Services Provider and Govt. Officer of grade 17

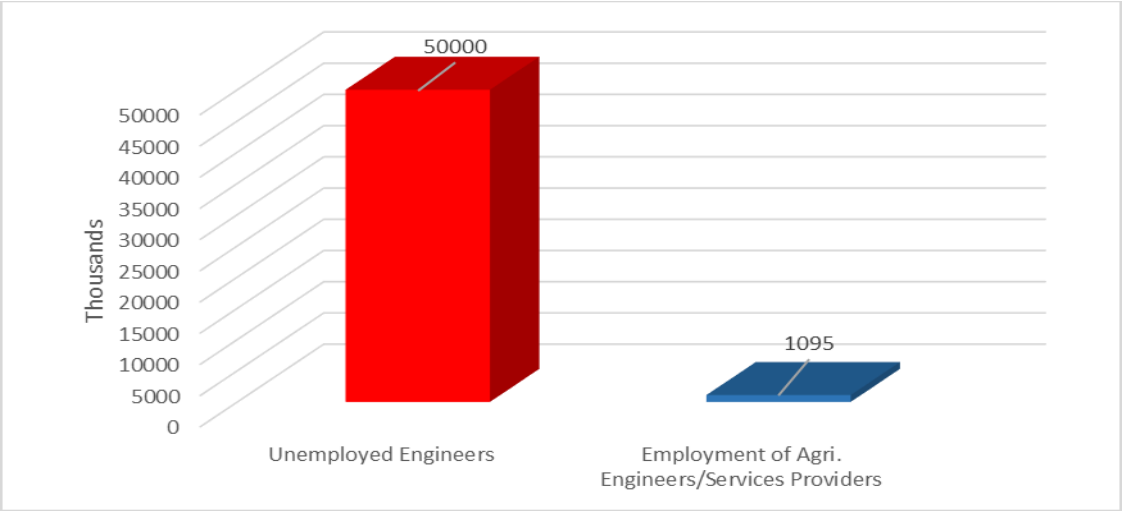


Figure 7: Agri. Engineers employment with respect to the whole engineering sectors unemployment

2.2.3.5 Machinery Holder's Profit

There should be two machinery owners in a village. The estimated profit of one machinery owner's shows that he can earn more than two thousand rupees per day, and can earn 74,880 rupees in a seasonal month. If he stays idle till next season it means that he earns 12,480 rupees per month. If only the amount of seasonal month is considered and compared with the salary of a government official of grade 17. This comparison shows that a machinery holder reaches almost equal to the salary of govt. official of BPS-17 in that seasonal month with an effort of only 8 hours, a day.

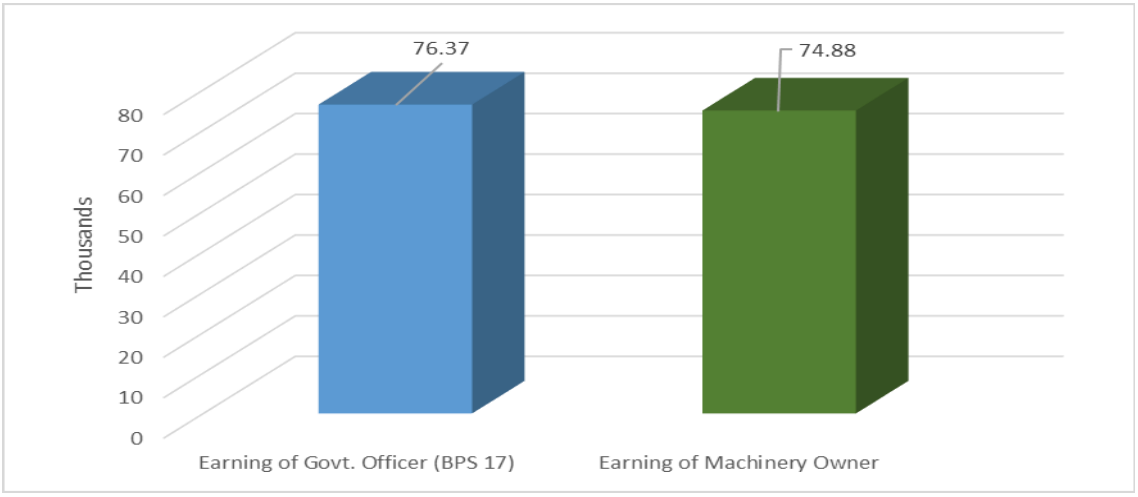


Figure 8: Comparison between Govt. officers' (BPS-17) monthly salary and Machinery Owner's seasonal month earning

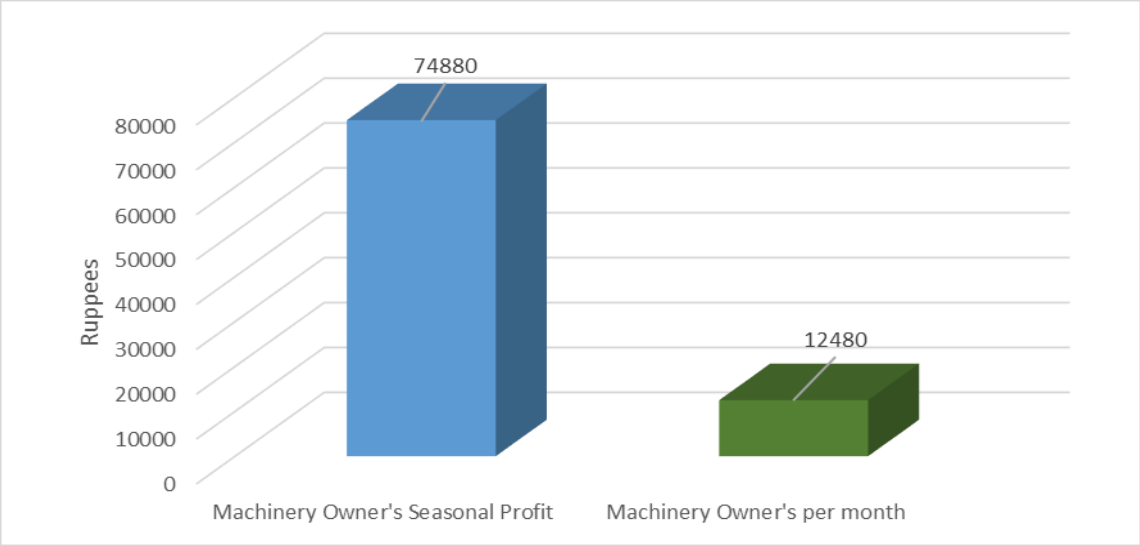


Figure 9: Machinery owner seasonal earning vs. per month earning

2.2.3.6 Shopkeeper's (Order Taker) Profit

There should be two Shopkeepers (Order Takers) in a village. The one shopkeeper profit estimation shows that he will earn Rs.22 per acre and Rs.6,240 on 312 acres in a season. Shopkeeper can consider order taking jobs, one more item in his shop giving him a profit of 20 rupees by booking/listing the order to the online portal. The comparison between per order and seasonal profit is shown in Figure 10.

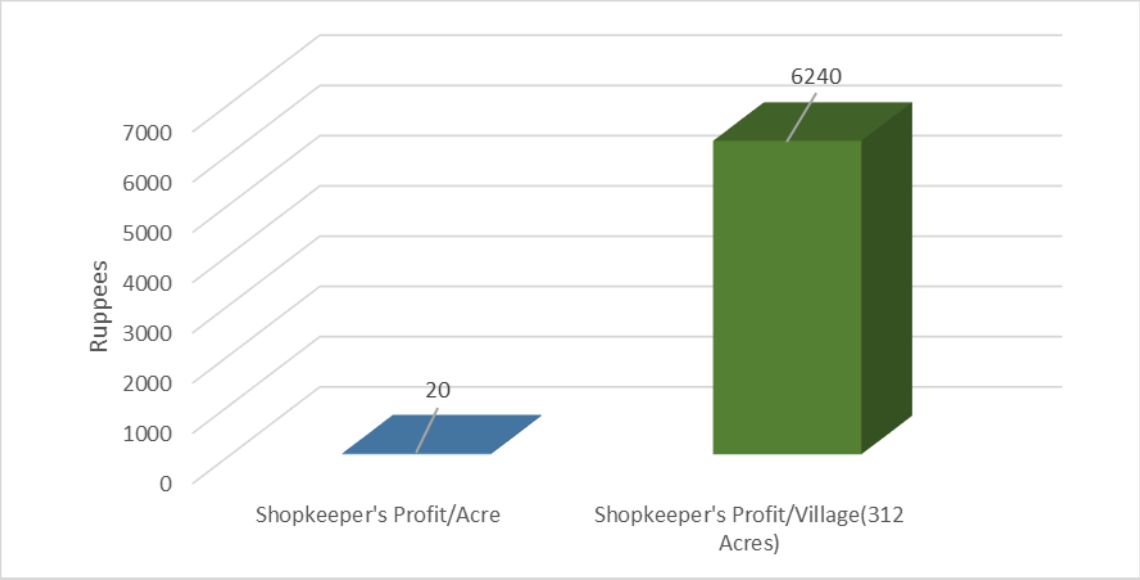


Figure 10: Shopkeeper's per acres Vs. 312 acres profit

2.3 PATTERN 3: Engineering related businesses through existing online systems

It is also possible for the engineering community to settle a business through existing online systems but the limitation is that they can do only online computer-based work i.e. report writing, report review or software based (AutoCAD, Proteus, PLC, etc.) work. Engineering practical work is possible by adopting the second pattern technique. This pattern is although profitable but time-consuming for making market, worldwide.

2.3.1 Existing Online Systems

a. Freelancer

b. Fiverr

c. Upwork etc.

2.4 Conclusion

a. These online support patterns can be used to reduce unemployment in engineering sectors.

b. Agriculture engineers can settle their businesses without capital investment and can play a vital role for the economy growth.

c. The suggested online agriculture system is based on only the services rate of cultivator, the involvement of other implements and machinery can reduce the working area without affecting the earnings of each stakeholder.

2.5 Recommendations

a. Agricultural machineries rent out management system should be adopted by fresh graduates of Agri. Engineering cadre. (Capacity is already declared through survey)

b. Government should promote fresh graduates by announcing flexible policies regarding their businesses.

c. Governmental and Non-Governmental organizations should conduct research studies regarding capacity declaration in engineering fields which would be more responsive, highly efficient and profitable for engineering community with the involvement of IT field.

d. The first and third patterns can be used for limited engineering works but the second one is most recommended and reliable for the engineering sectors after capacity declaration.

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[2]. https://www.focus-economics.com/economic-indicator/unemployment-rate

[3]. https://www.focus-economics.com/economic-indicator/unemployment-rate

[4]. https://www.ceicdata.com/en/indicator/pakistan/unemployment-rate

[5]. http://www.agripunjab.gov.pk/overview%20new

Smog: A Major Environment Hazard

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Pakistan Meteorological Department
Islamabad

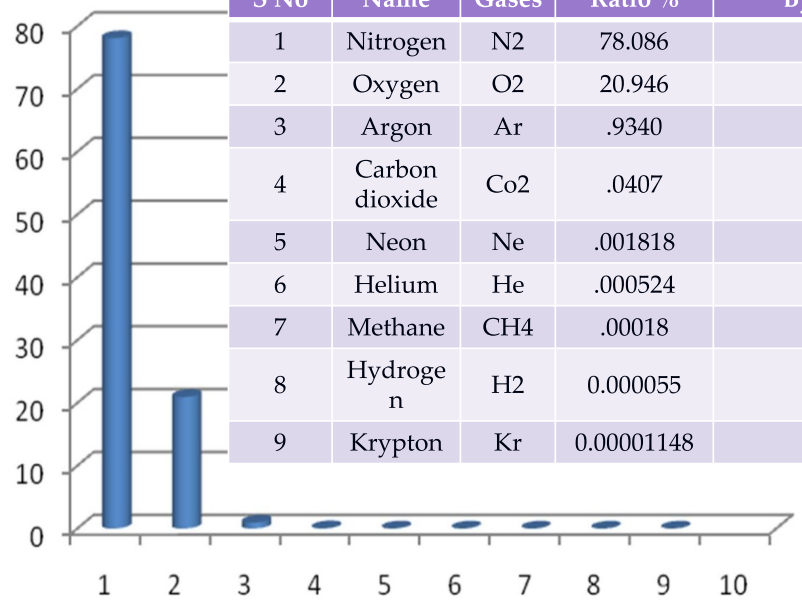
Scheme of presentation

- Introduction
- Smog and types
- Atmospheric condition
- Meteorological condition
- Inversion layer
- Impact of unstable atmosphere
- Conclusion

Introduction

- Natural Air
- Aerosol
- Smog

The Natural Ratio of Gases In Air



S No	Name	Gases	Ratio %	By Volume
1	Nitrogen	N2	78.086	780,840
2	Oxygen	O2	20.946	209,460
3	Argon	Ar	.9340	9,340
4	Carbon dioxide	Co2	.0407	400
5	Neon	Ne	.001818	18.18
6	Helium	He	.000524	5.24
7	Methane	CH4	.00018	1.79
8	Hydrogen	H2	0.000055	
9	Krypton	Kr	0.00001148	

Aerosols

- Solid or liquid particles, existed in the atmosphere
- They are available in the form of dust, soot, sea salt
- They have diameter of 0.001 to 10 microns

Aerosol

- Primary aerosols, volcanic ash , dust, organic materials from biomass burning, soot from combustion and mineral dust from wind-blown processes
- Secondary aerosols include sulphates from the oxidation of sulphur containing gases during the burning of fossil fuels, nitrates from gaseous nitrogen species, and products from the oxidation of volatile organic compounds (VOCs).

Smog

- Is a type of air pollution
- Is also the type of fog which has smoke or soot in it.
- Is a **yellowish or blackish fog** formed mainly by a mixture of pollutants in the atmosphere which consists of fine particles and ground level ozone.
- Smog is the **mixture of various gases** with **dust and water vapour.**

Types of Smog

- Sulfurous Smog
- Atmospheric Condition
  - Humid
  - Stable
  - Cold



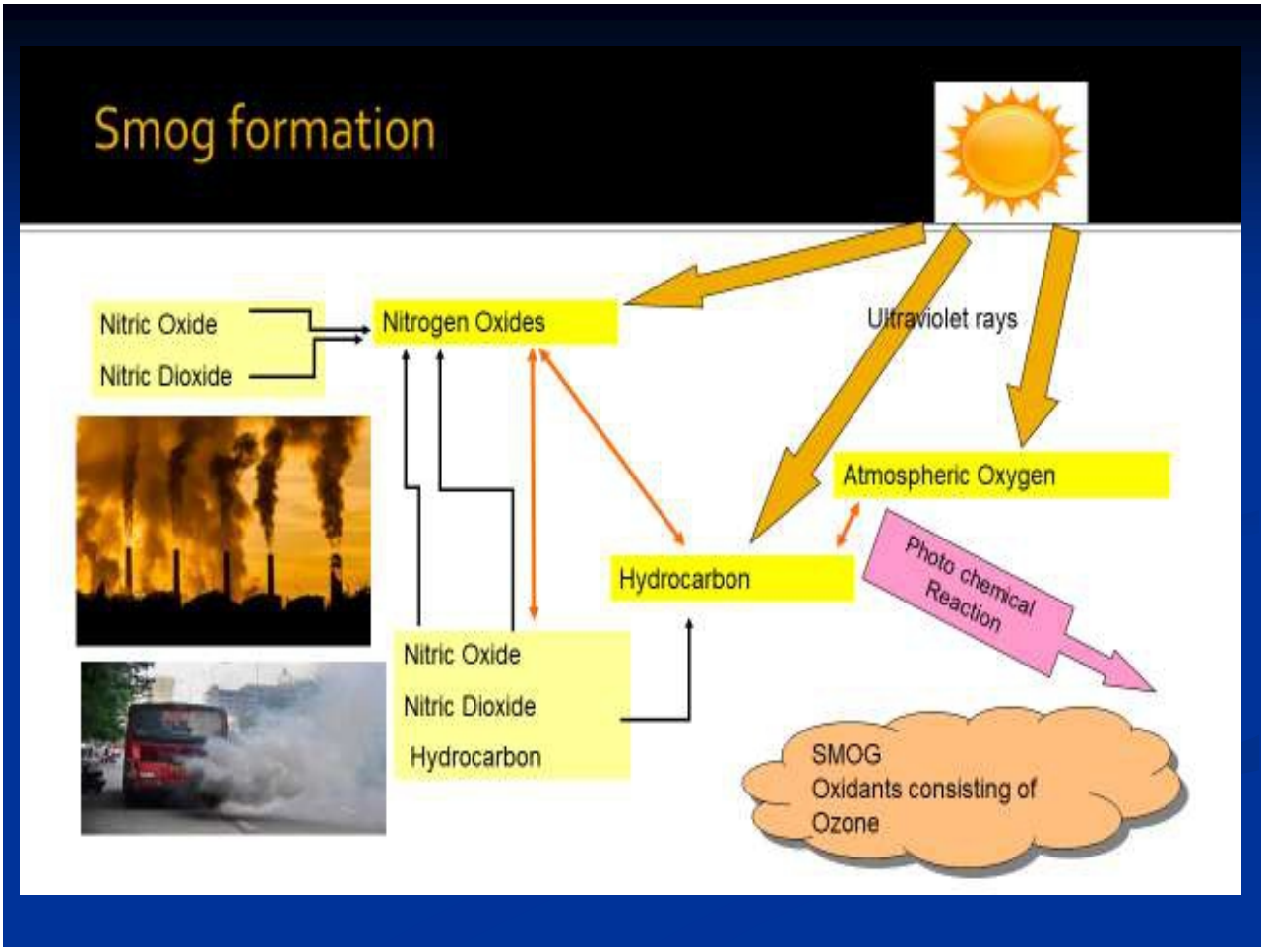
- Causes

  Emission of
  1 Fossil fuel
  2 Coal burning

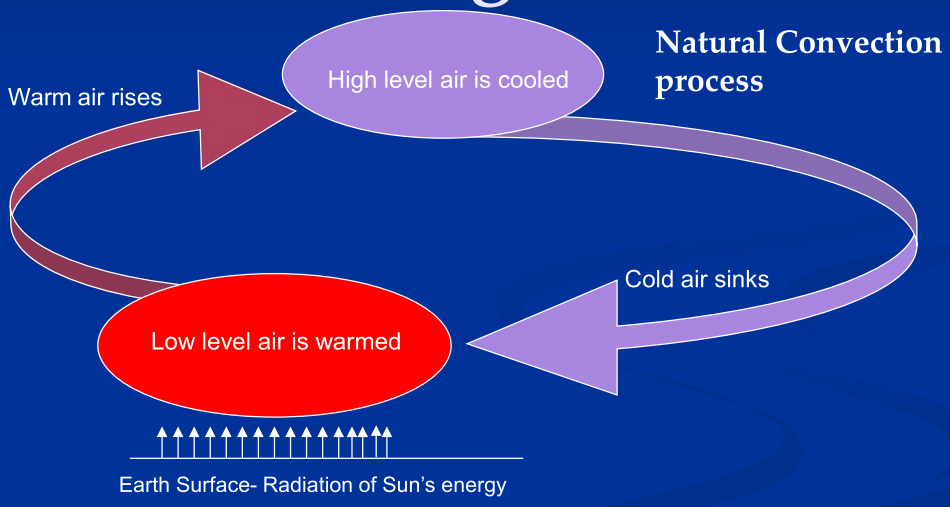
- sulfur , Nitrous Oxide -Primary Pollutant
- chemical reaction cause sulfurous and sulfuric Acid which is secondary pollutant

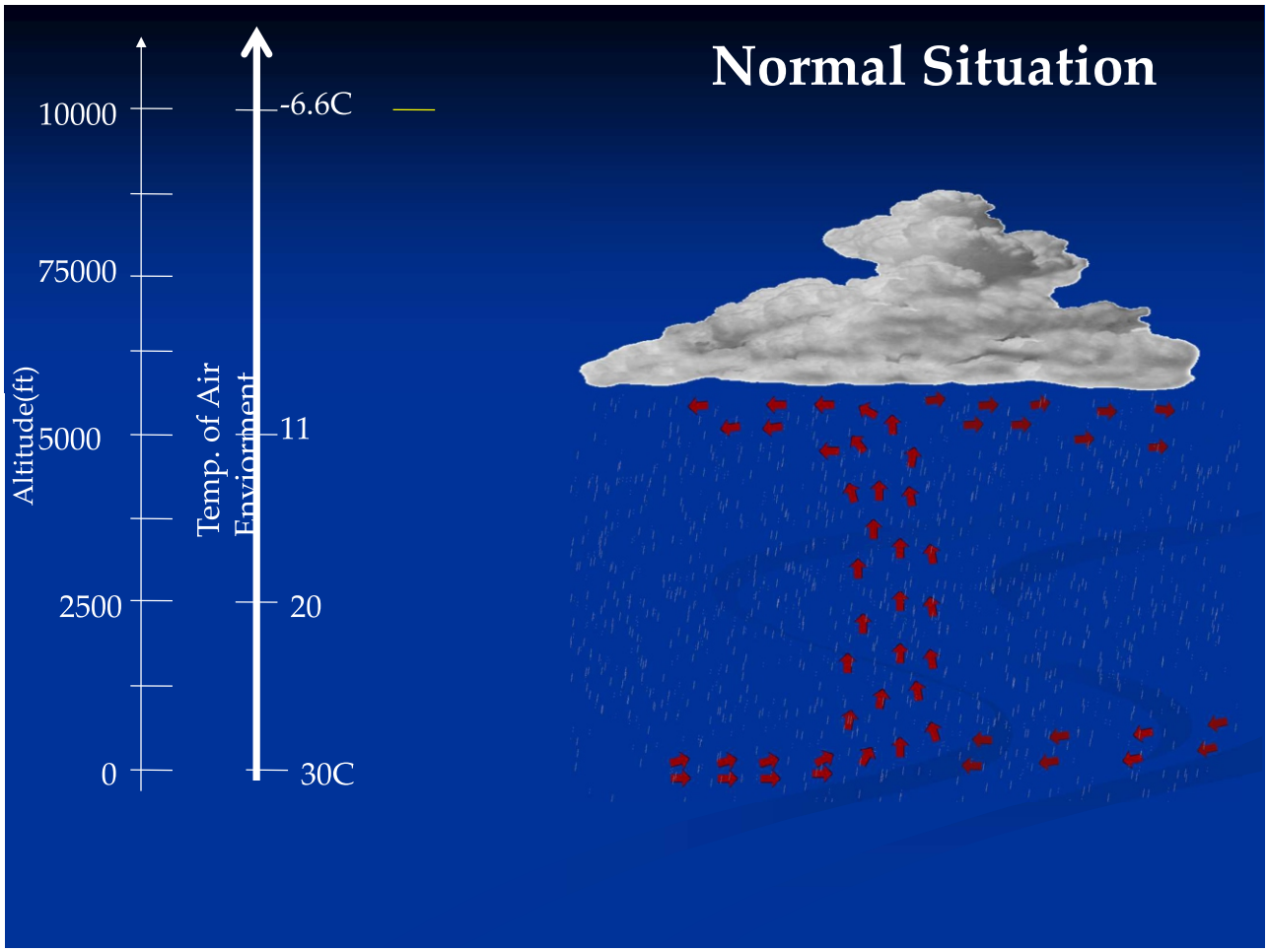
Photochemical Smog

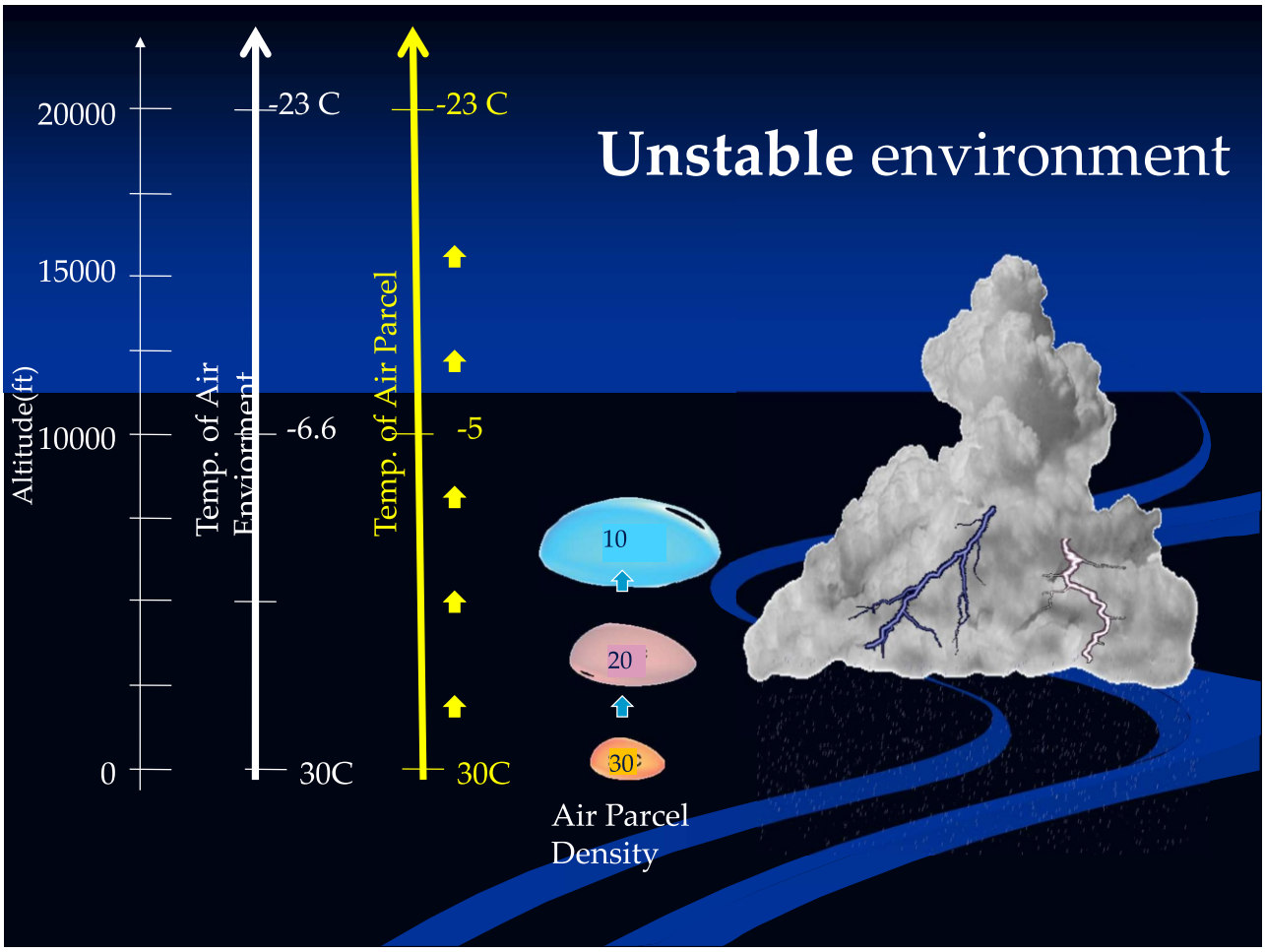
- Atmospheric condition
  - Dry
  - Hot
  - Sunny
- Smoke releases from internal combustion engine
- Hydrocarbons
- Nitrogen oxides Primary pollutants
- Form secondary pollutant
- Ammonia ,Nitric Acid ,Nitrous oxide and Ozone

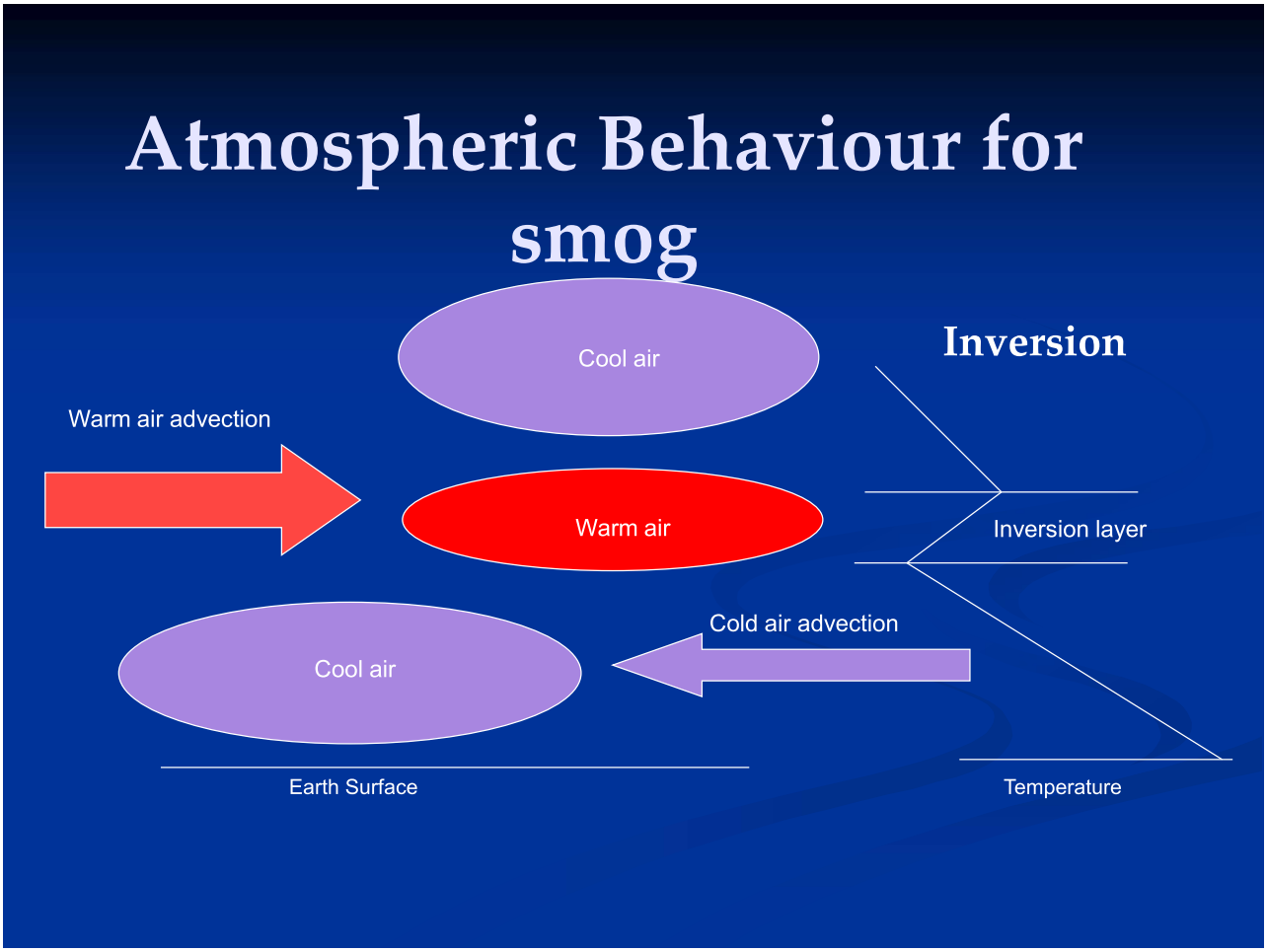


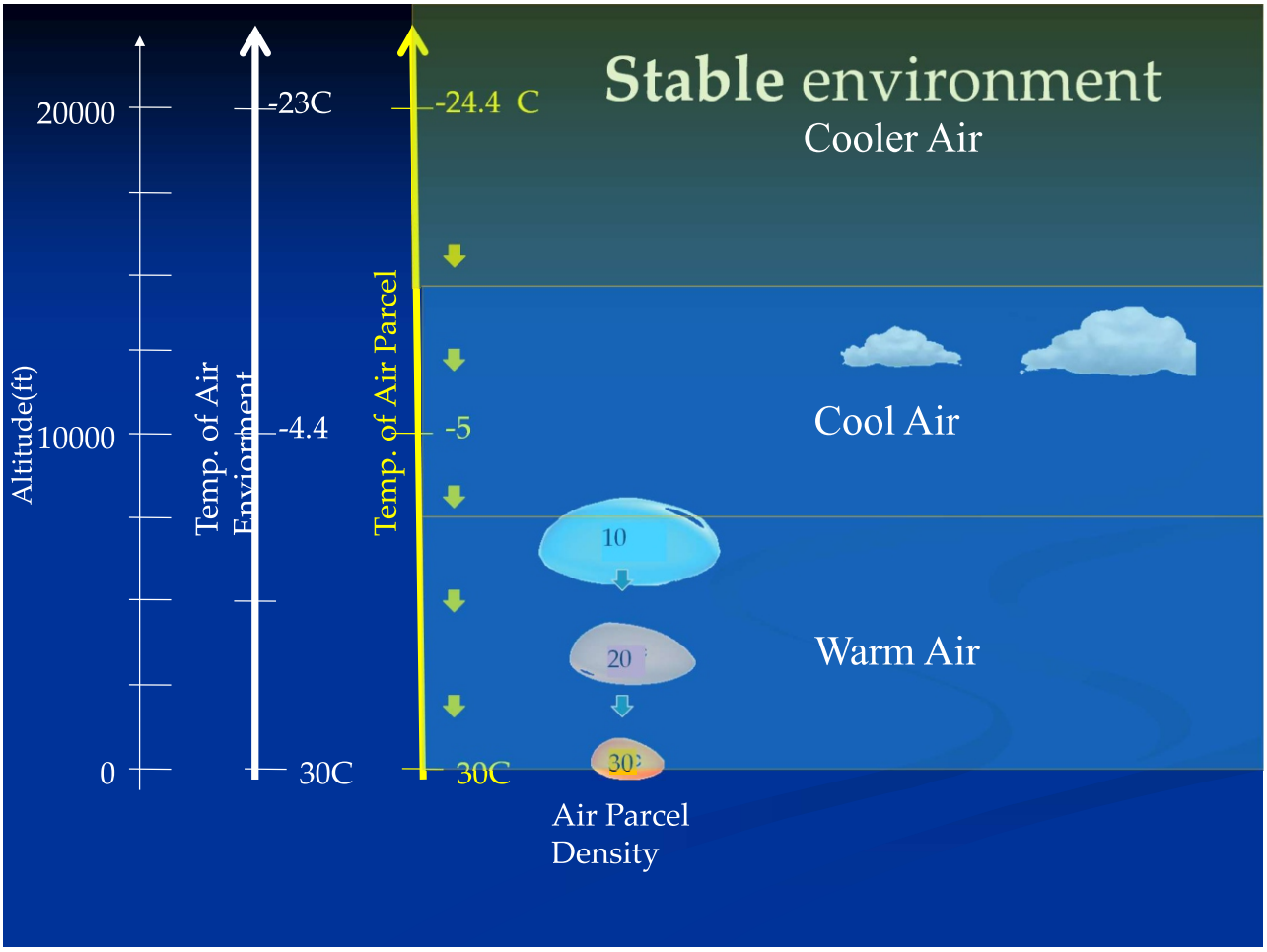
Atmospheric Behaviour for smog

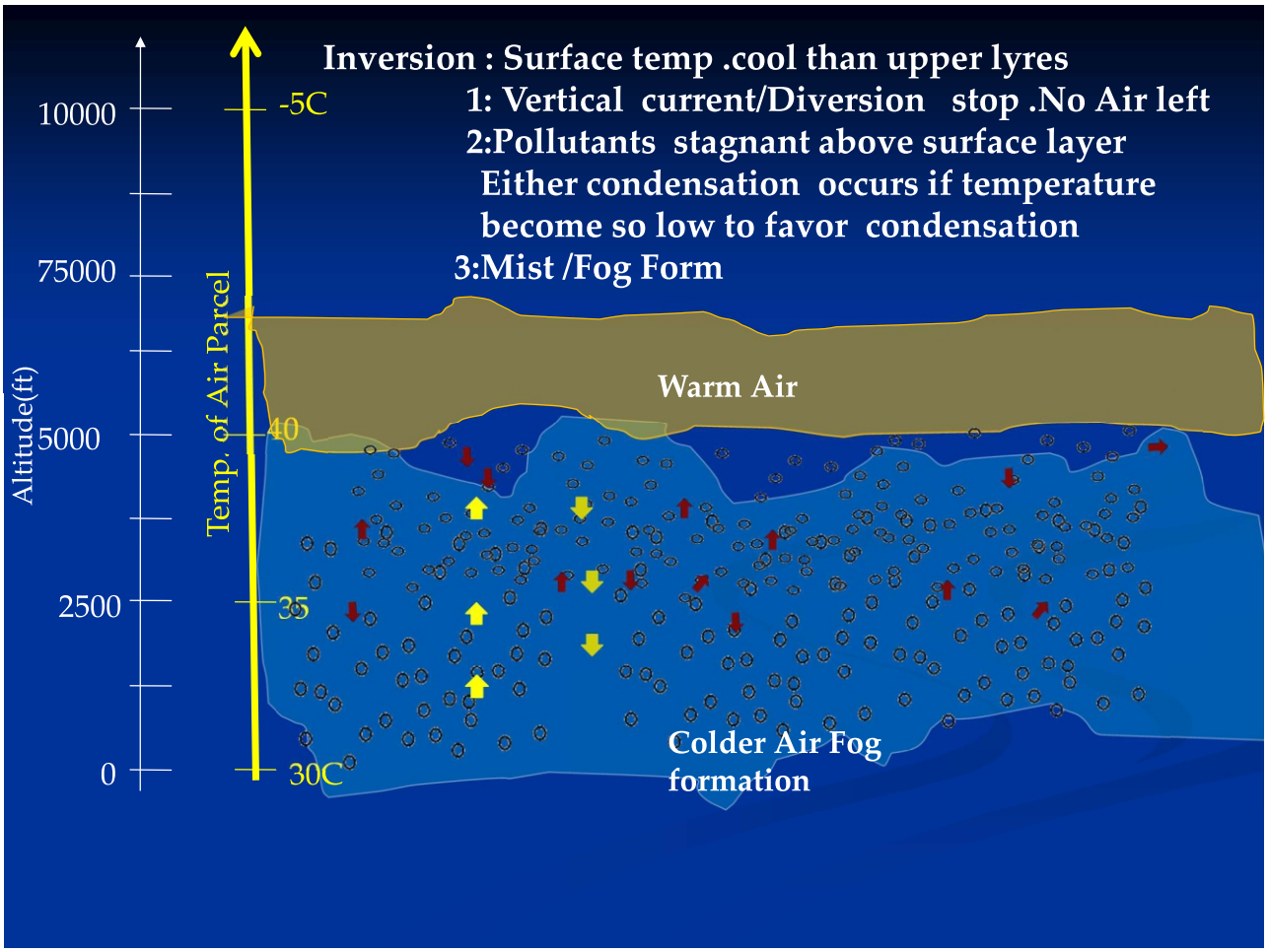


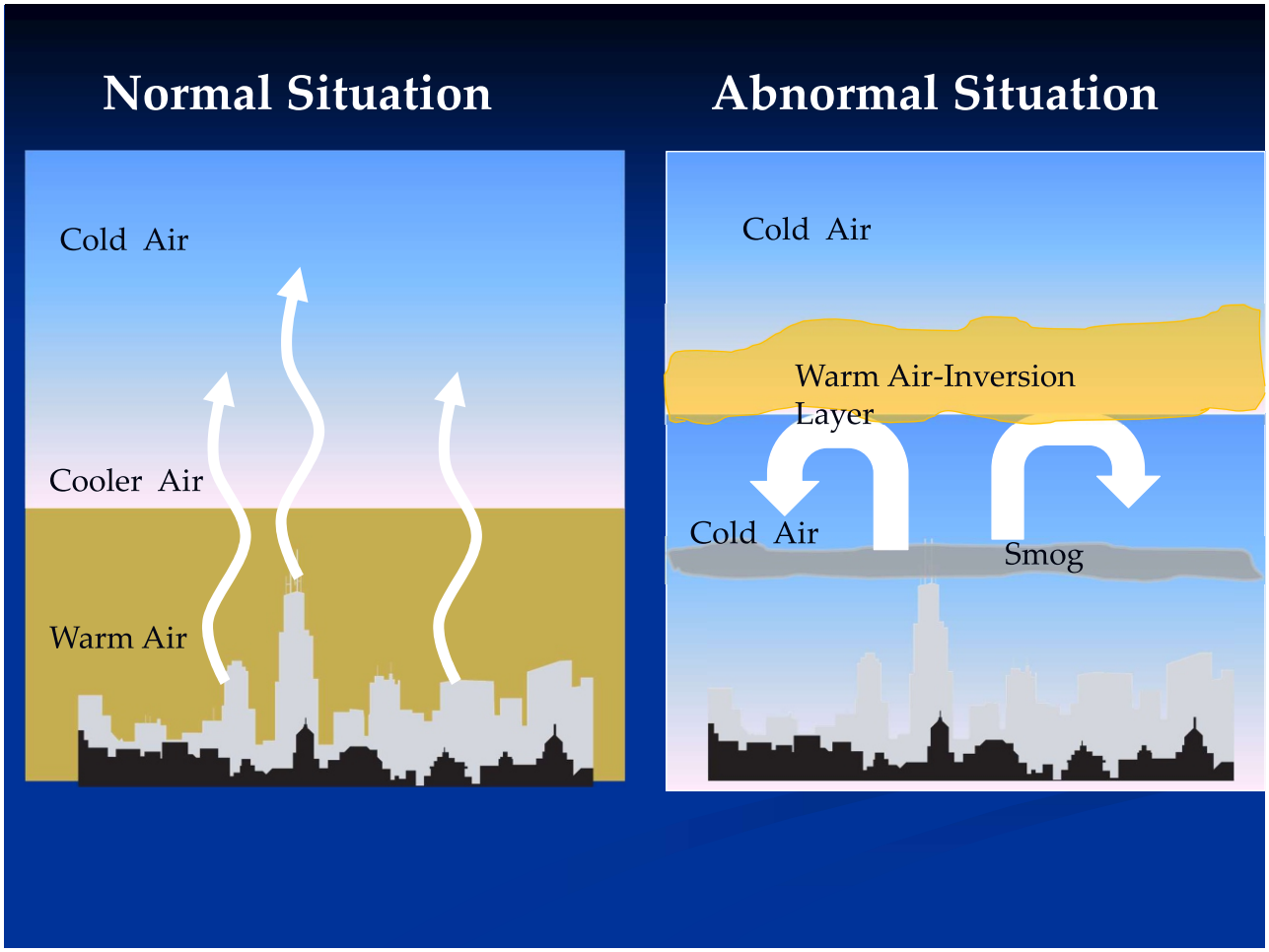


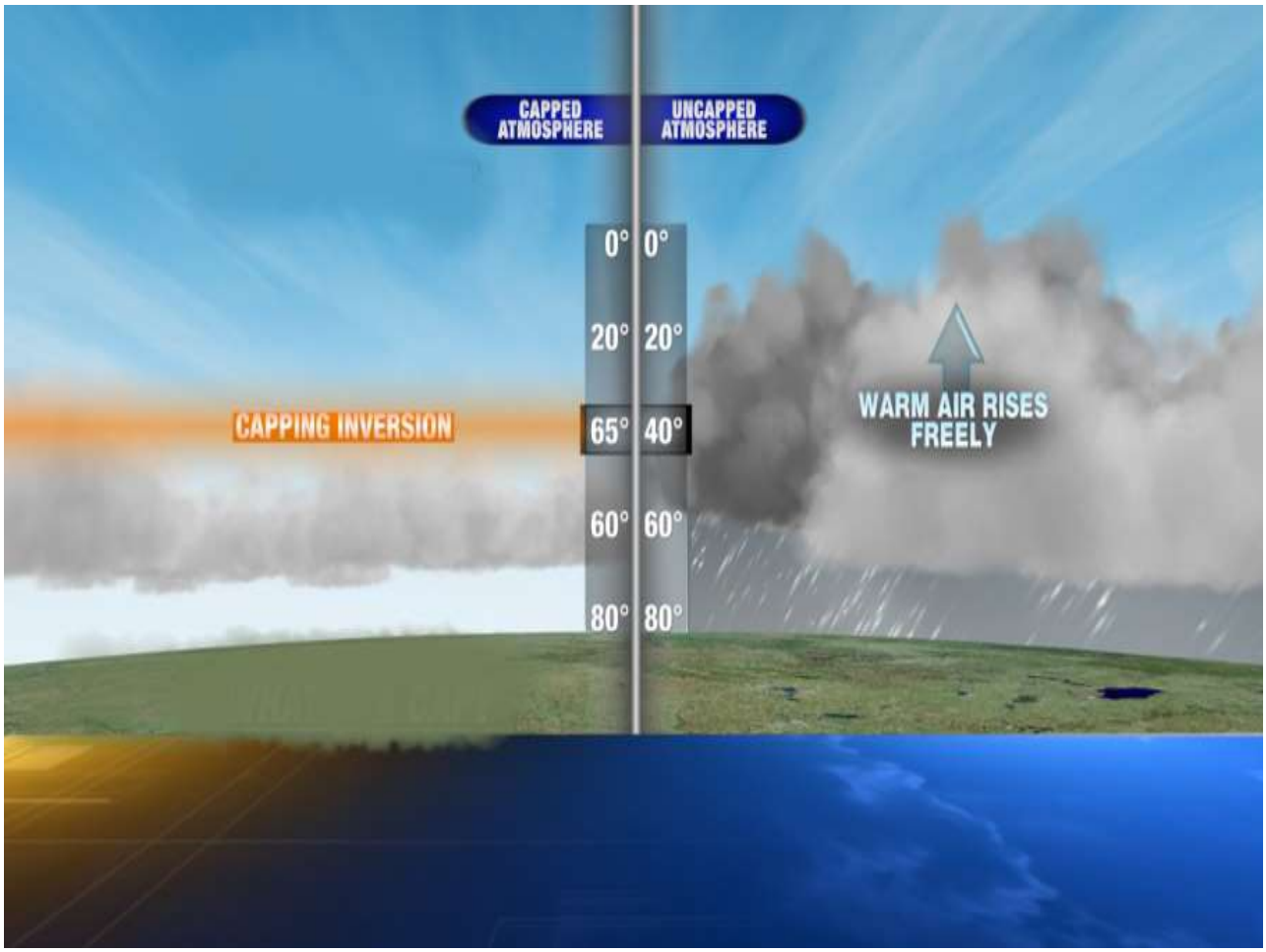

Unstable environment
20000
15000
10000
0
Altitude(ft)
Temp. of Air Enviorment
-23 C
-6.6
30C
Temp. of Air Parcel
-23 C
-5
30C
10
20
30
Air Parcel Density


Atmospheric Behaviour for smog
Cool air
Inversion
Warm air advection
Warm air
Inversion layer
Cold air advection
Cool air
Earth Surface
Temperature


Stable environment
Cooler Air
Cool Air
Warm Air
Altitude(ft)
20000
10000
0
Temp. of Air Environment
-23C
-4.4
30C
Temp. of Air Parcel
-24.4 C
-5
30C
10
20
30
Air Parcel Density

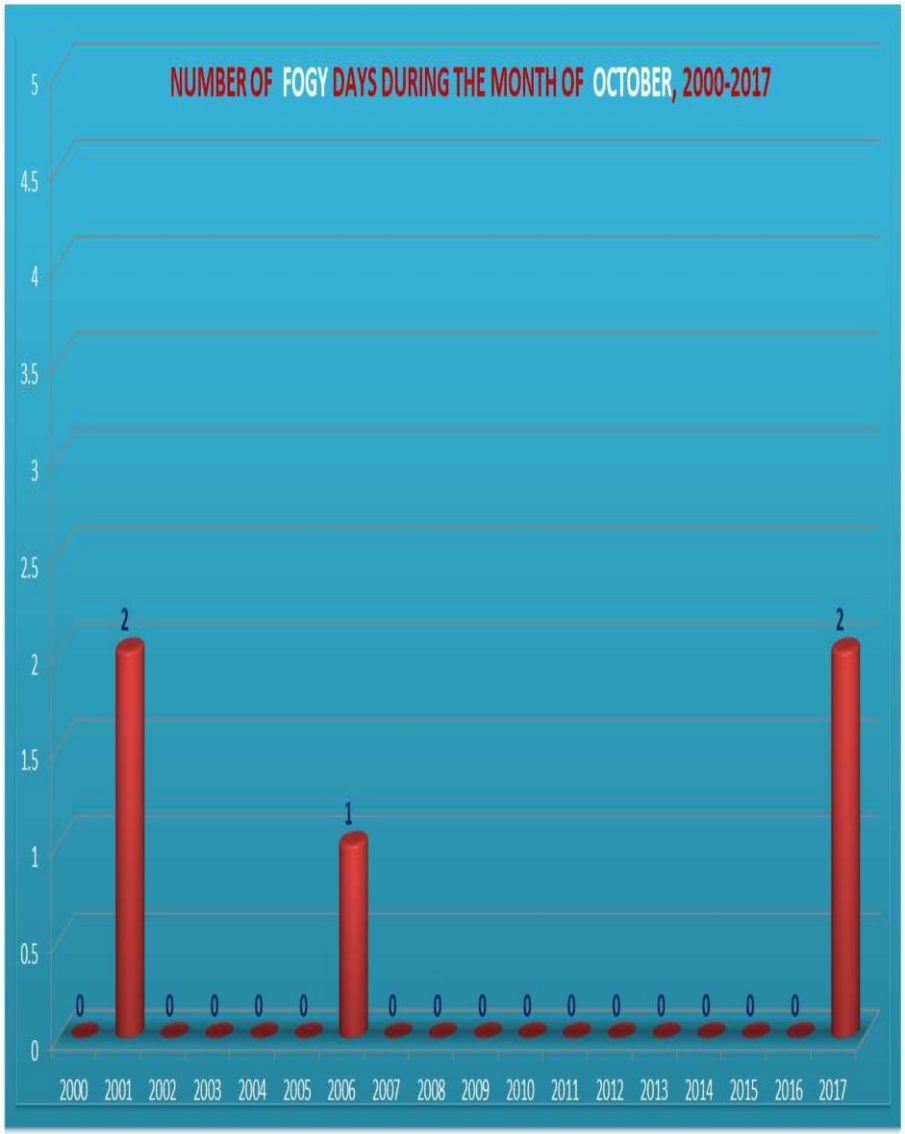

Inversion : Surface temp .cool than upper lyres
1: Vertical current/Diversion stop .No Air left
2:Pollutants stagnant above surface layer
Either condensation occurs if temperature become so low to favor condensation
3:Mist /Fog Form
Warm Air
Colder Air Fog formation
Altitude(ft)
10000
75000
5000
2500
0
Temp. of Air Parcel
-5C
40
35
30C

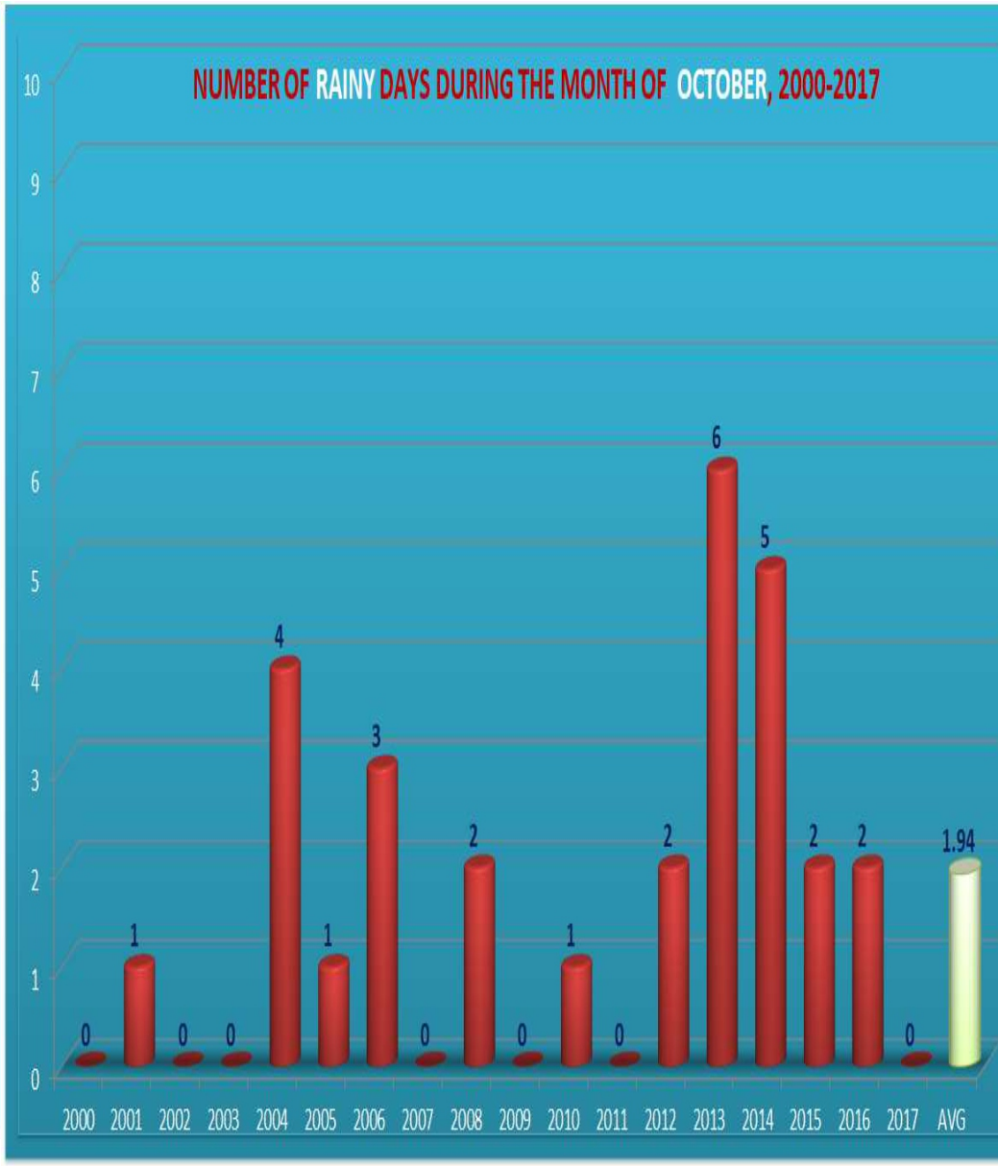

Normal Situation
Abnormal Situation
Cold Air
Cooler Air
Warm Air
Cold Air
Warm Air-Inversion Layer
Cold Air
Smog

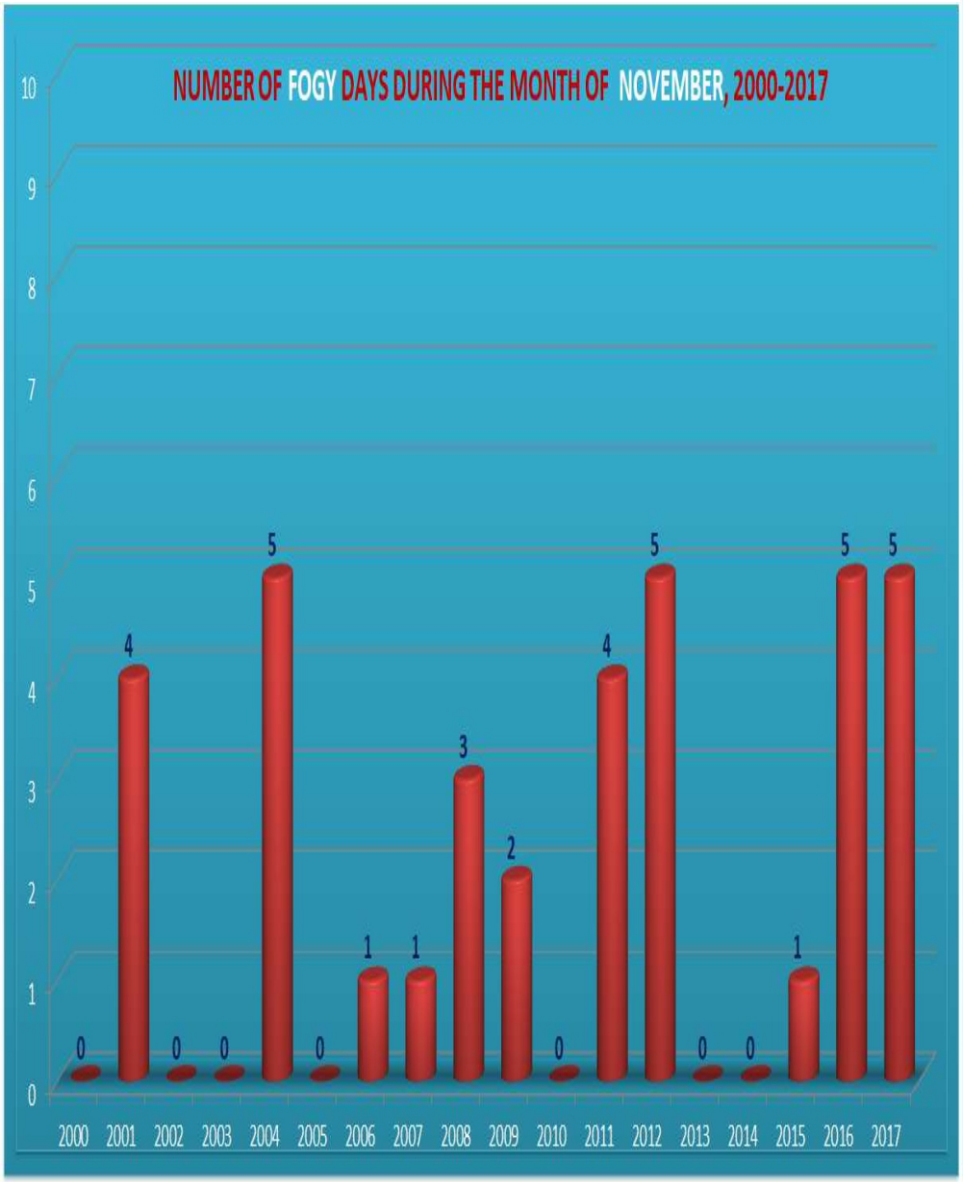

CAPPED ATMOSPHERE
UNCAPPED ATMOSPHERE
0° 0°
20° 20°
CAPPING INVERSION
65° 40°
WARM AIR RISES FREELY
60° 60°
80° 80°

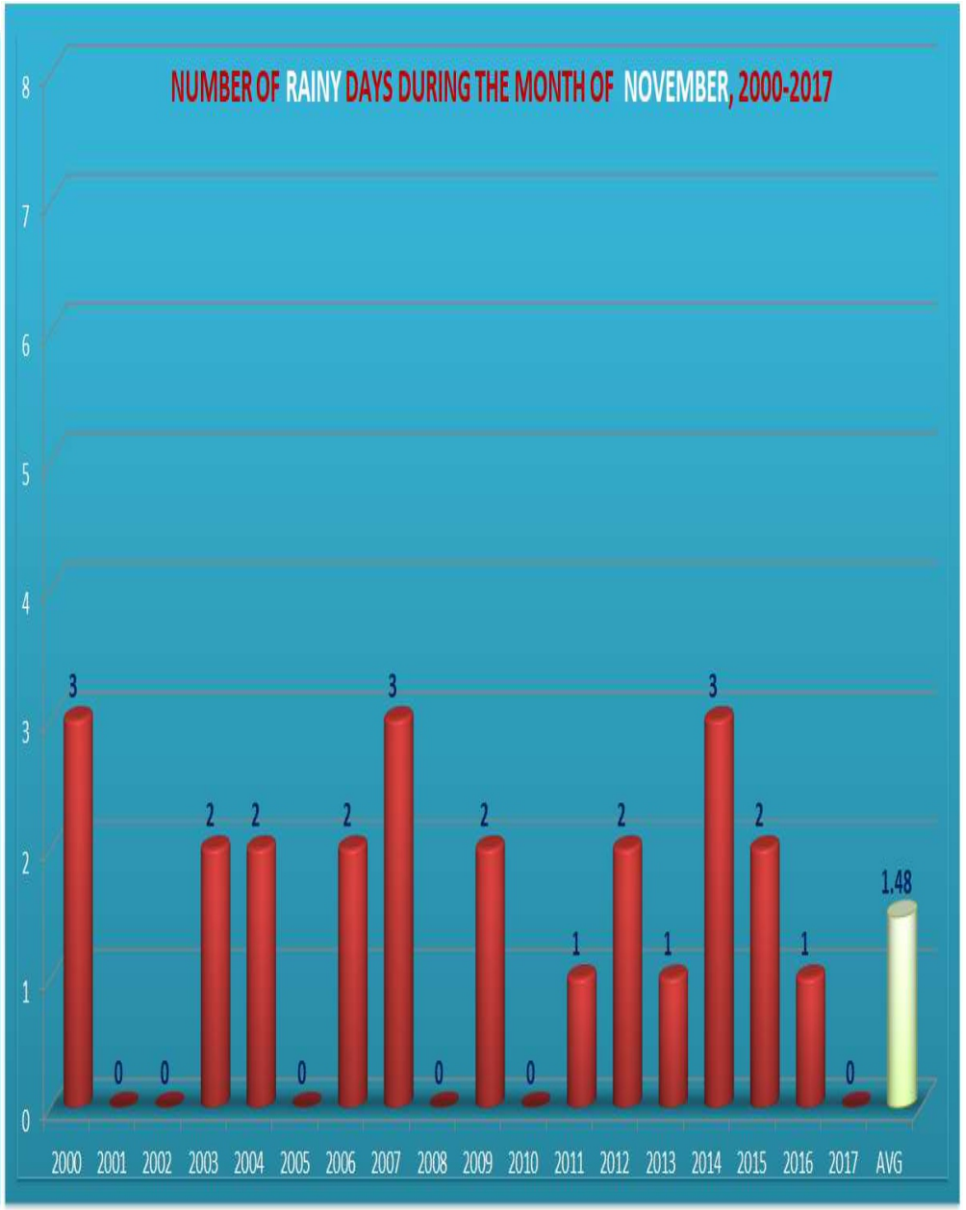
Why inversion layer is formed

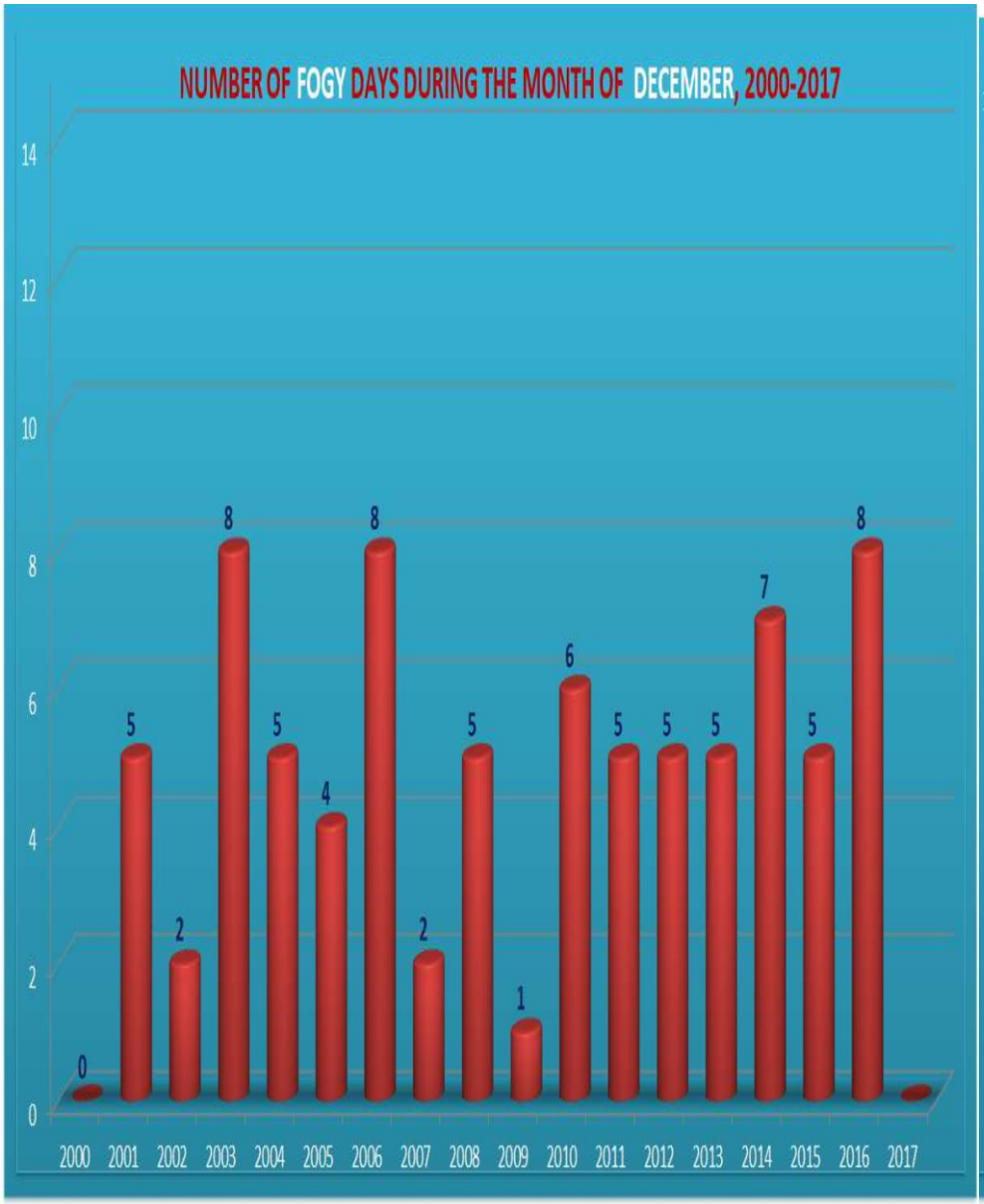
- There are **four kinds of inversions**:
  - Ground
  - Turbulence
  - Subsidence
  - Frontal

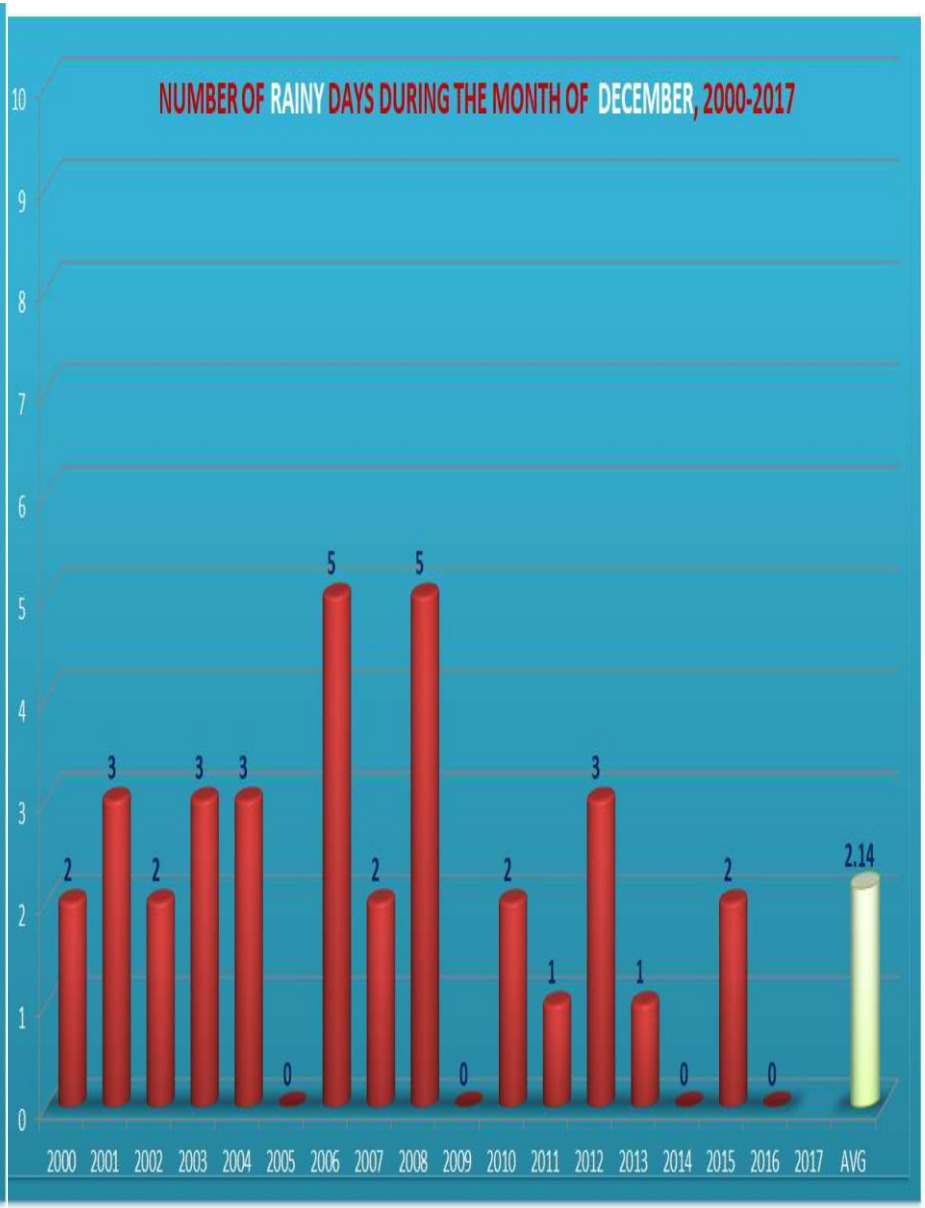

NUMBER OF FOGY DAYS DURING THE MONTH OF OCTOBER, 2000-2017
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0 2 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 2
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


NUMBER OF RAINY DAYS DURING THE MONTH OF OCTOBER, 2000-2017
10
9
8
7
6
5
4
3
2
1
0
0 1 0 0 4 1 3 0 2 0 1 0 2 6 5 2 2 0 1.94
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 AVG


NUMBER OF FOGY DAYS DURING THE MONTH OF NOVEMBER, 2000-2017
0 1 2 3 4 5 6 7 8 9 10
0 4 0 0 5 0 1 1 3 2 0 4 5 0 0 1 5 5
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


NUMBER OF RAINY DAYS DURING THE MONTH OF NOVEMBER, 2000-2017
0 1 2 3 4 5 6 7 8
3 0 0 2 2 0 2 3 0 2 0 1 2 1 3 2 1 0 1.48
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 AVG

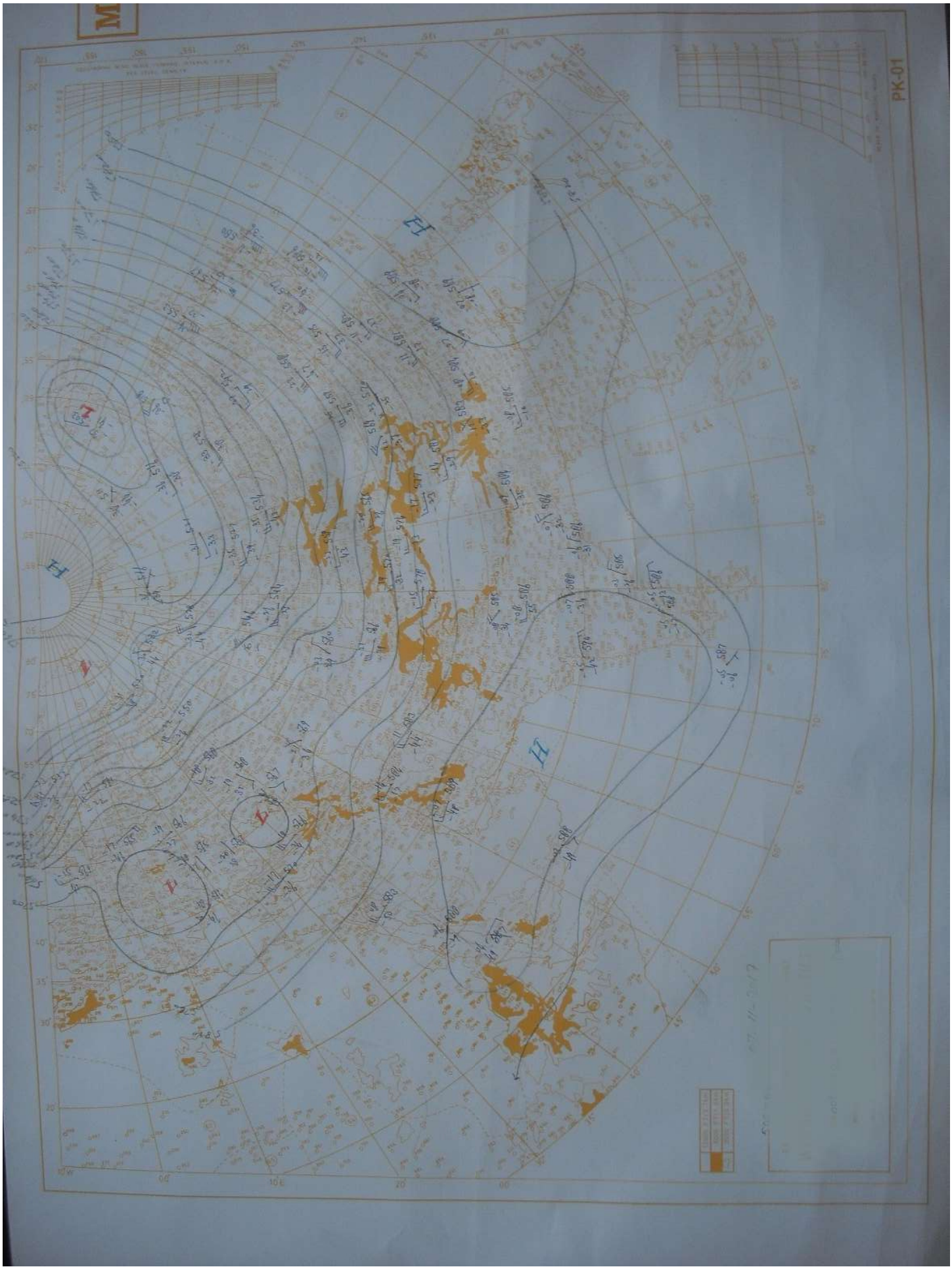

NUMBER OF FOGY DAYS DURING THE MONTH OF DECEMBER, 2000-2017
0 2 4 6 8 10 12 14
0 5 2 8 5 4 8 2 5 1 6 5 5 5 7 5 8
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017


NUMBER OF RAINY DAYS DURING THE MONTH OF DECEMBER, 2000-2017
0 1 2 3 4 5 6 7 8 9 10
2 3 2 3 3 0 5 2 5 0 2 1 3 1 0 2 0 2.14
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 AVG

study of Smog in Lahore



PK-01


PK-01

Satellite Image

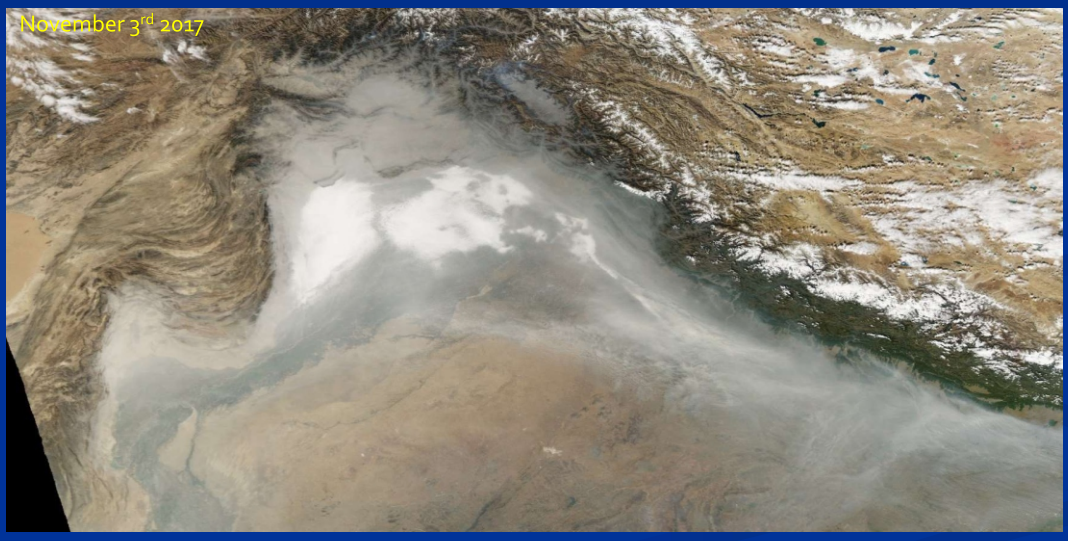
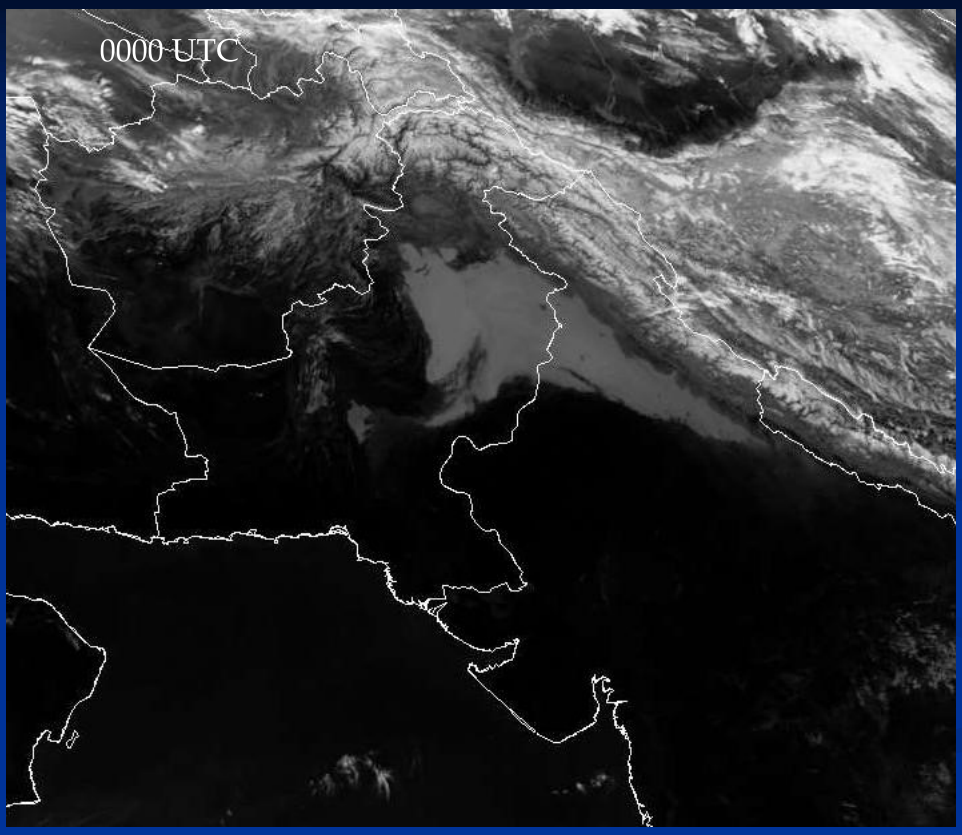
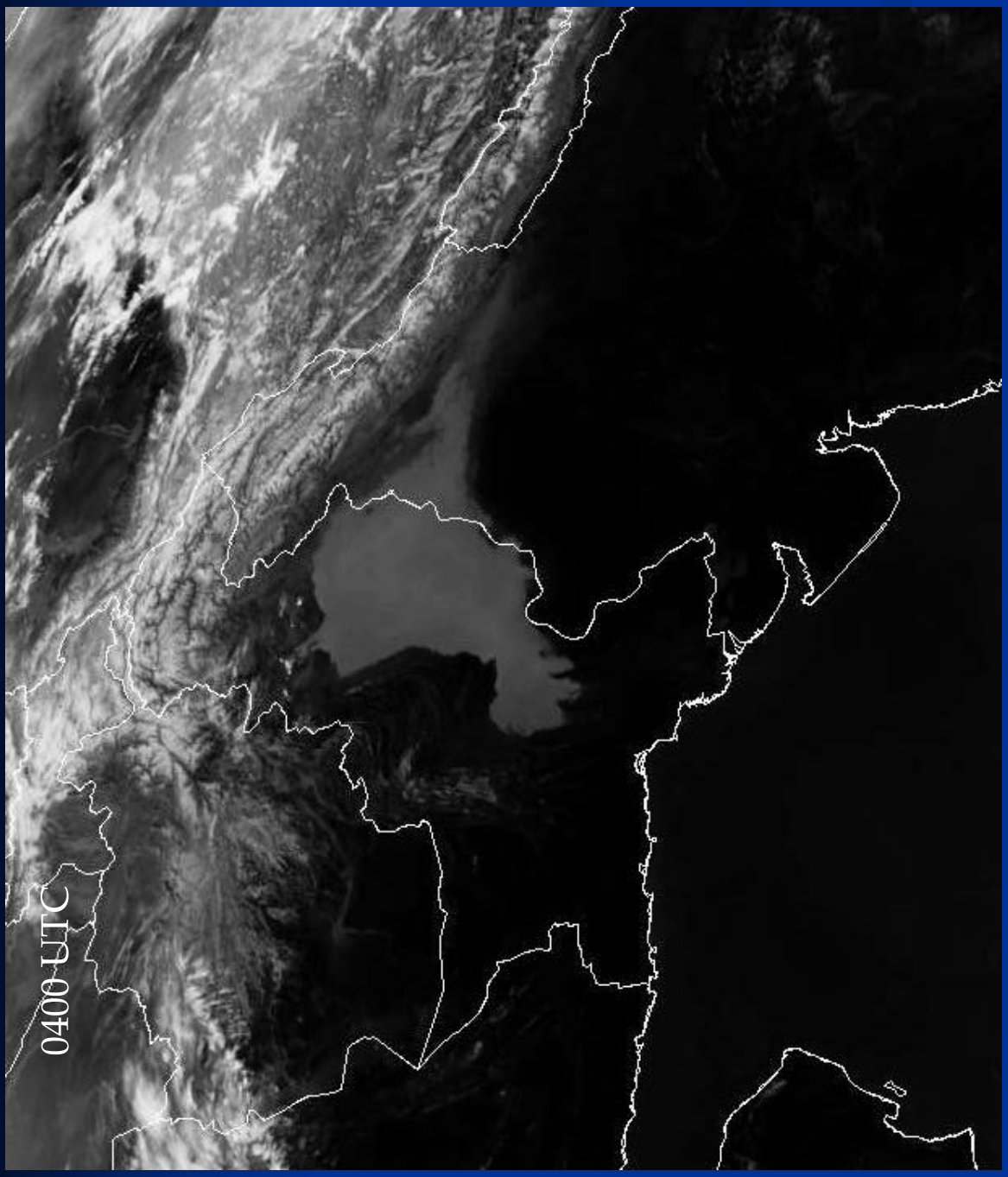
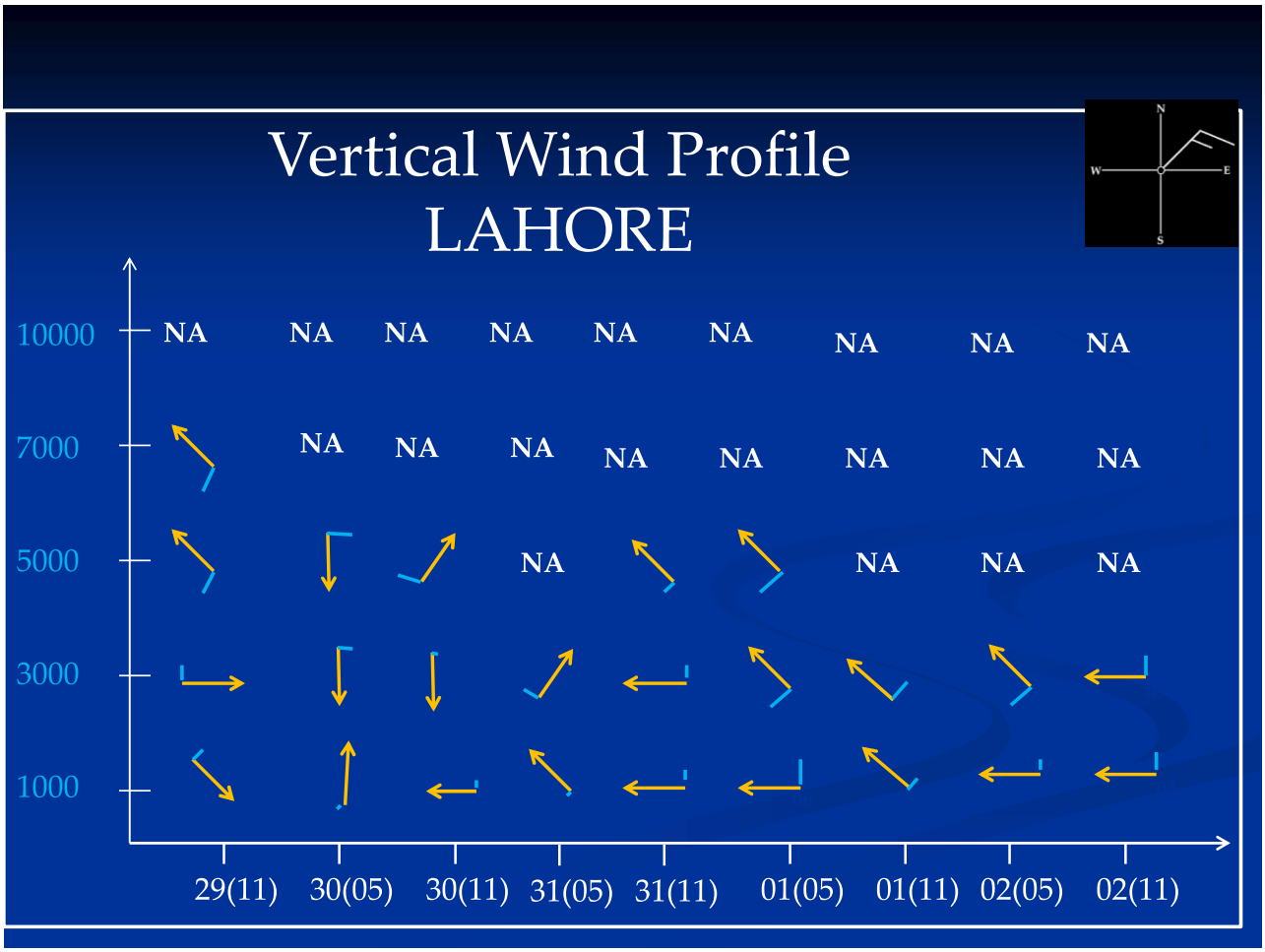
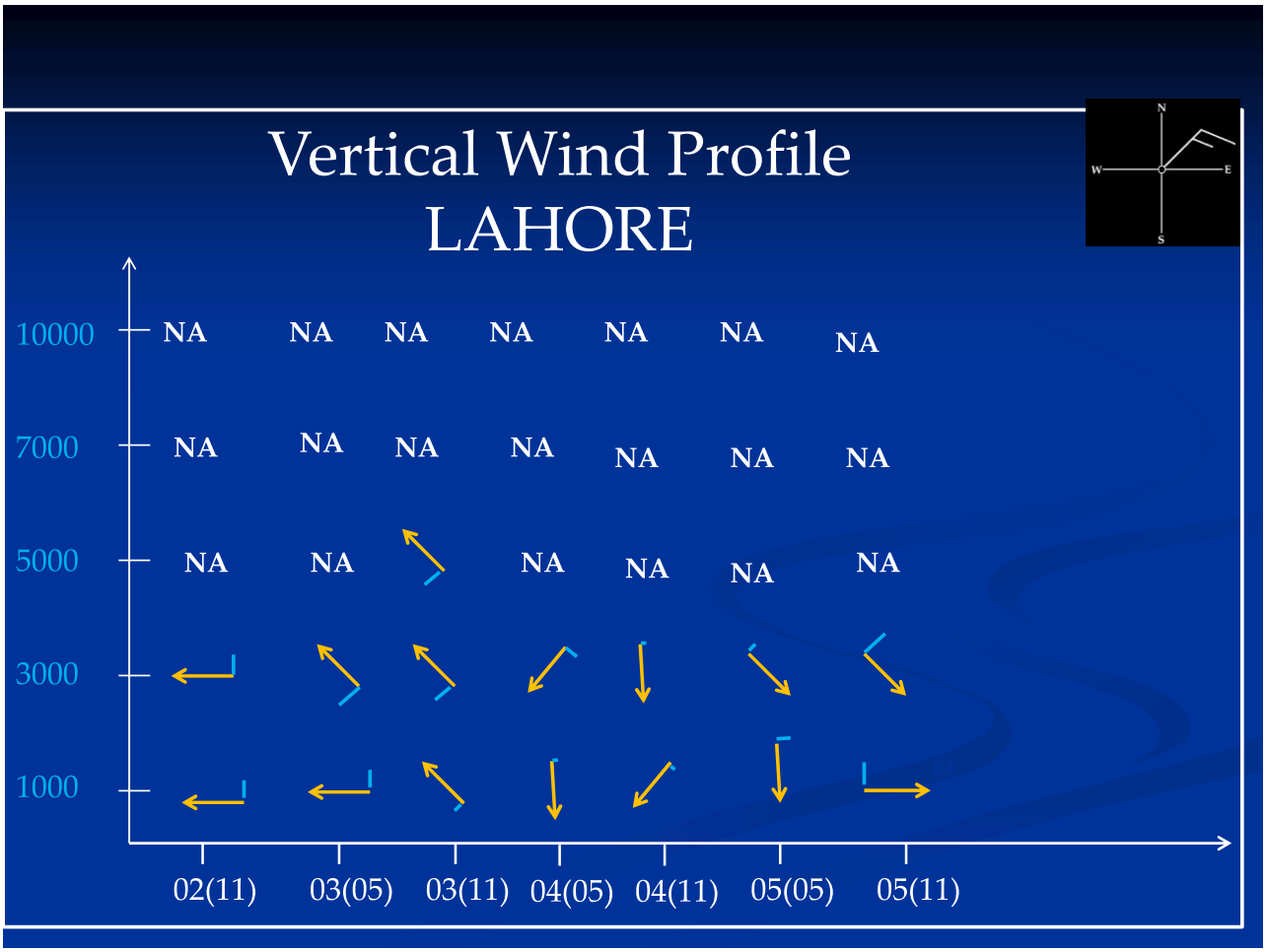


Image @ NASA Earth Observatory

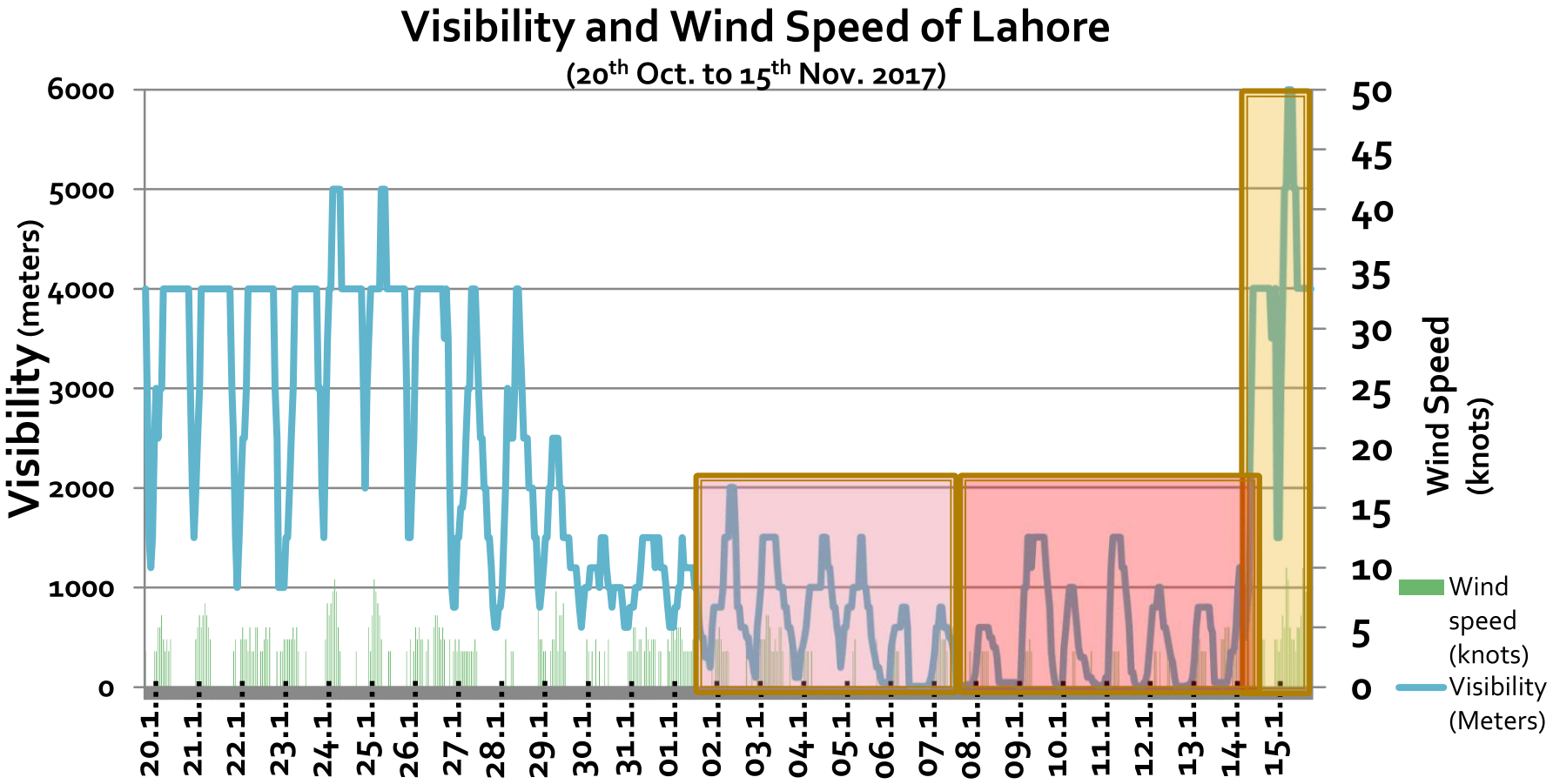



0400 UTC

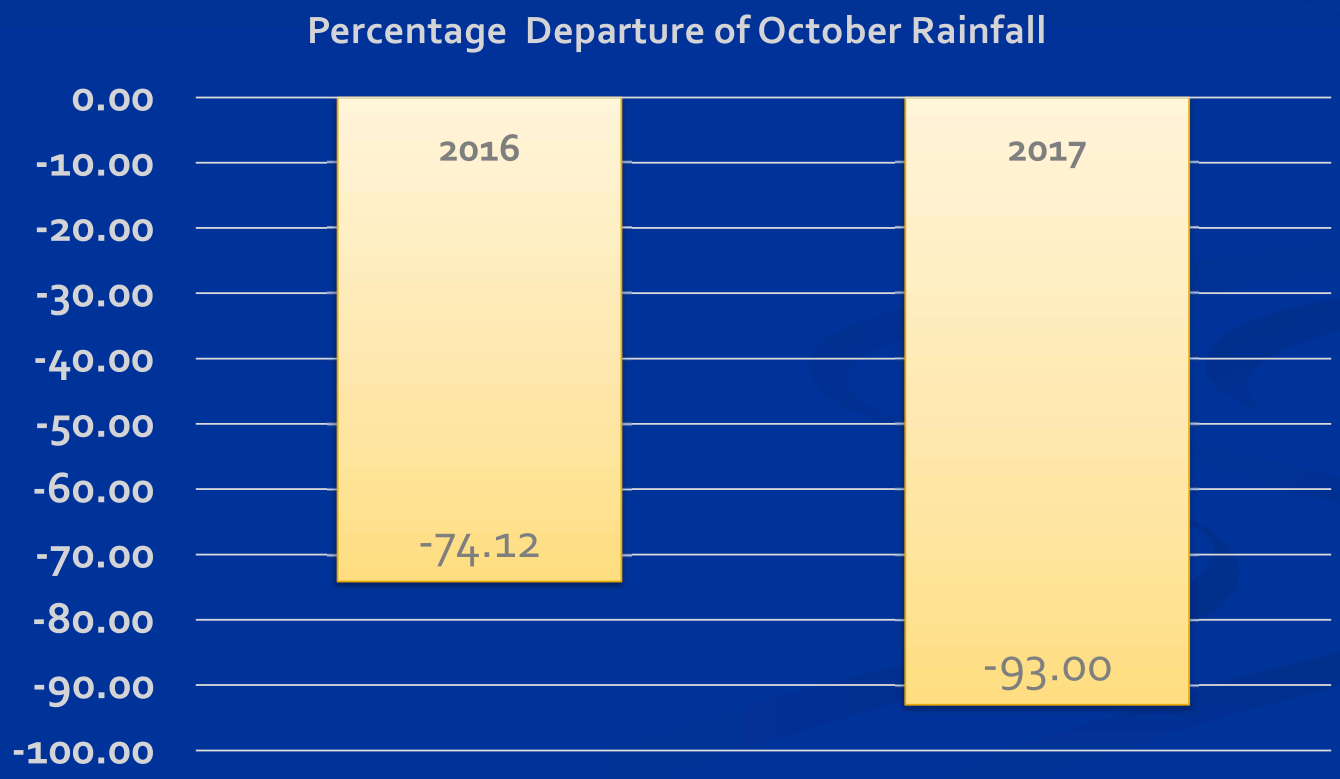

Vertical Wind Profile
LAHORE
N
W
E
S
10000
7000
5000
3000
1000
NA
29(11)
30(05)
30(11)
31(05)
31(11)
01(05)
01(11)
02(05)
02(11)


Vertical Wind Profile
LAHORE
N
W
E
S
10000
7000
5000
3000
1000
NA
02(11)
03(05)
03(11)
04(05)
04(11)
05(05)
05(11)

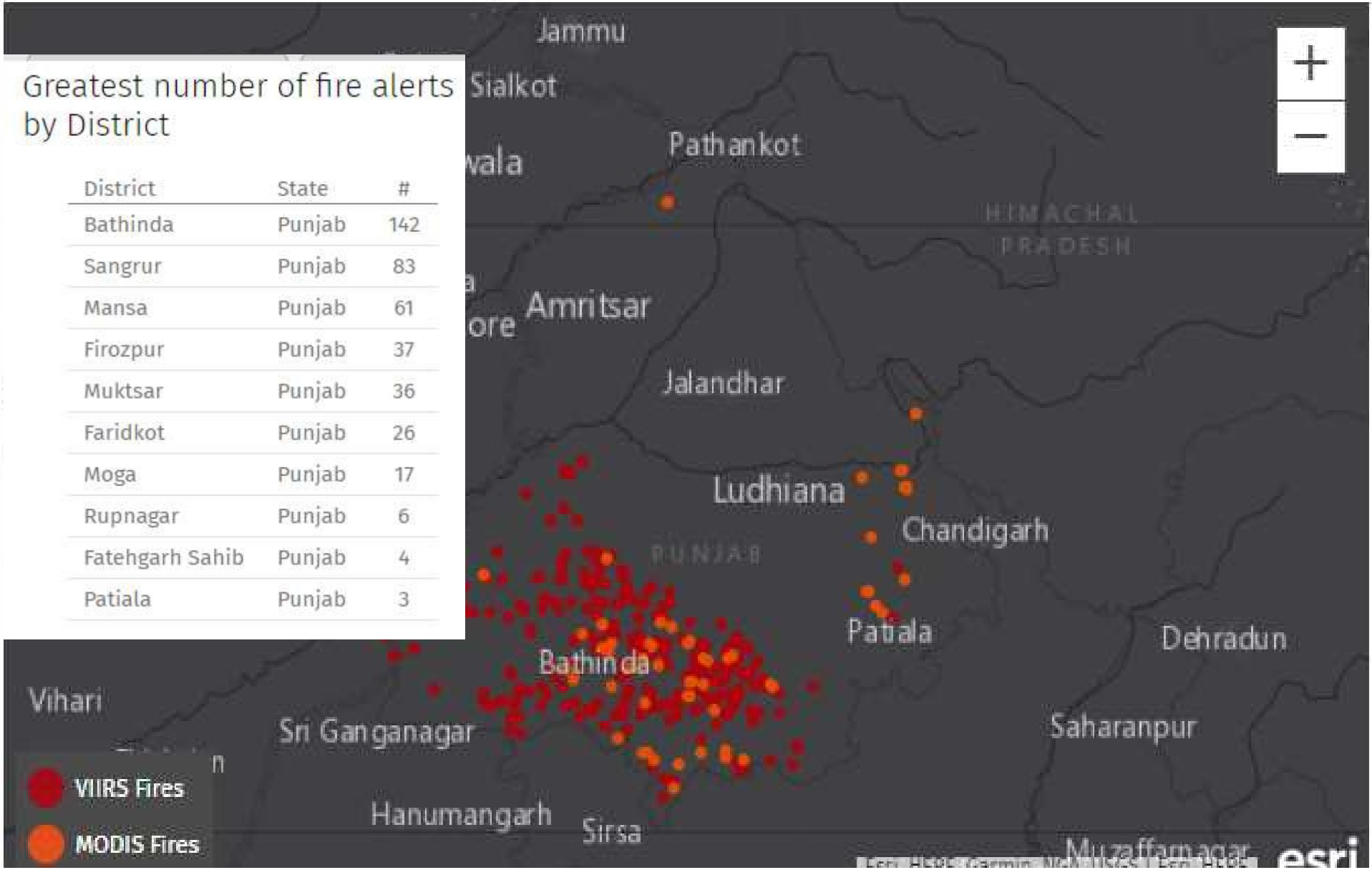
Meteorological Parameters



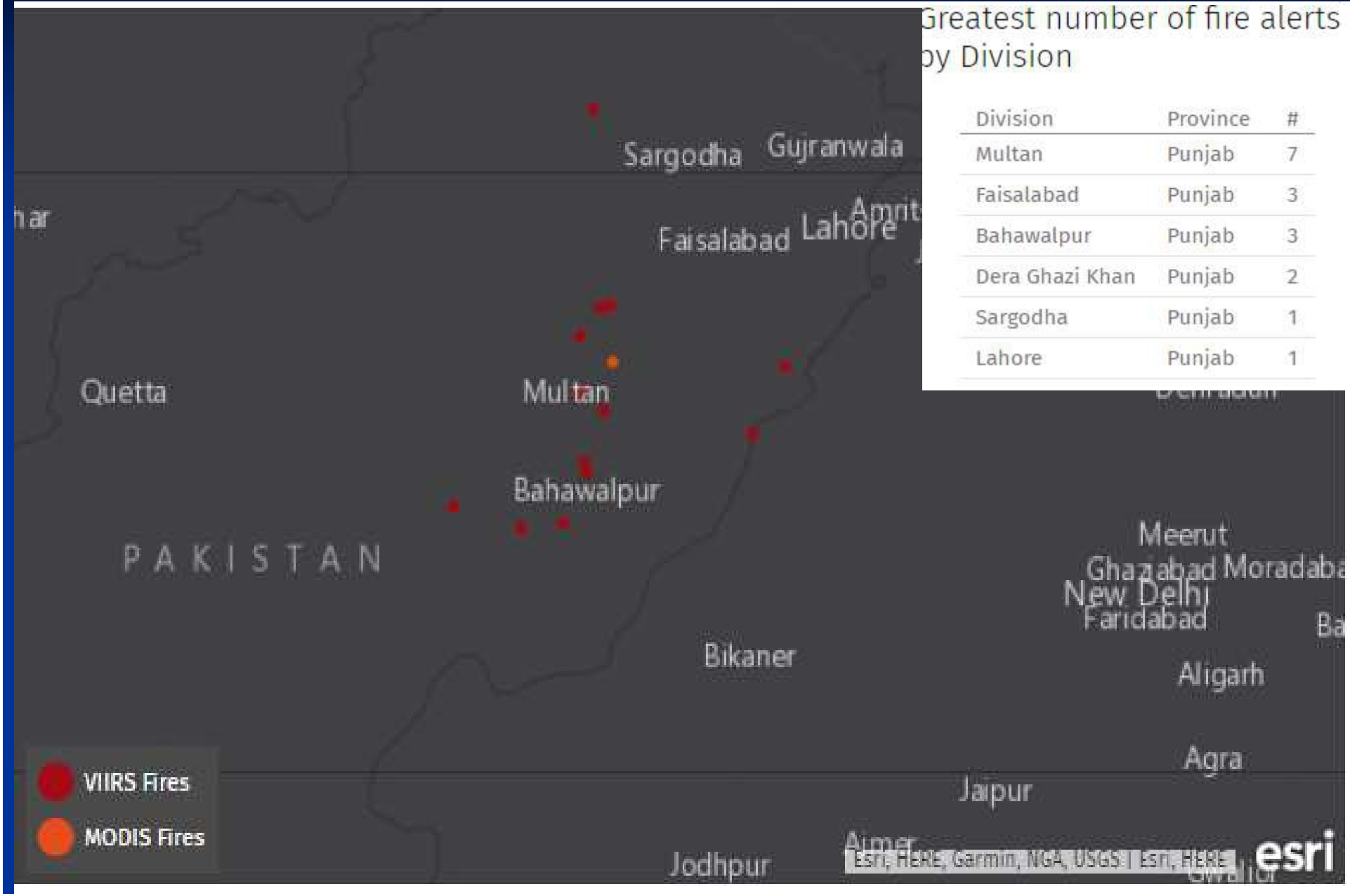
Meteorological Parameters



Agriculture Fire Clusters 07 Nov.



Agriculture Fire Clusters 07 Nov.

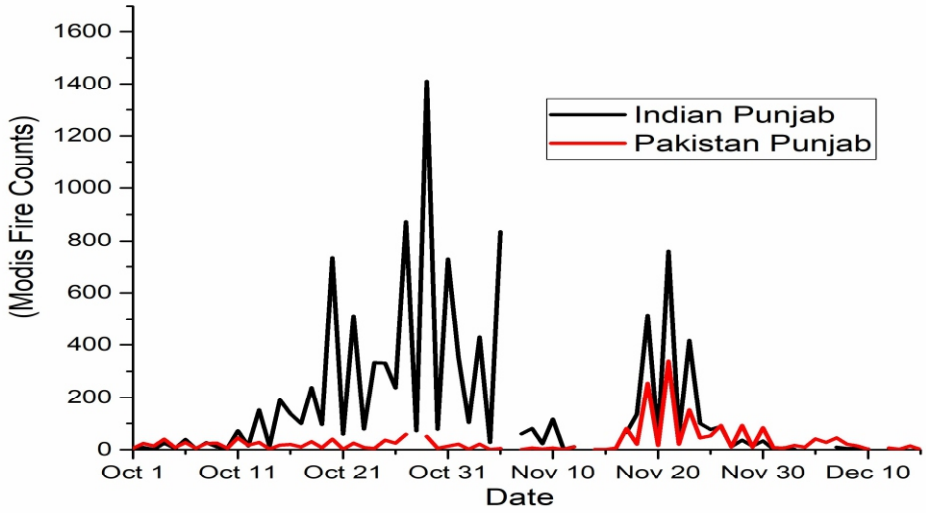


Greatest number of fire alerts by Division

Division	Province	#
Multan	Punjab	7
Faisalabad	Punjab	3
Bahawalpur	Punjab	3
Dera Ghazi Khan	Punjab	2
Sargodha	Punjab	1
Lahore	Punjab	1

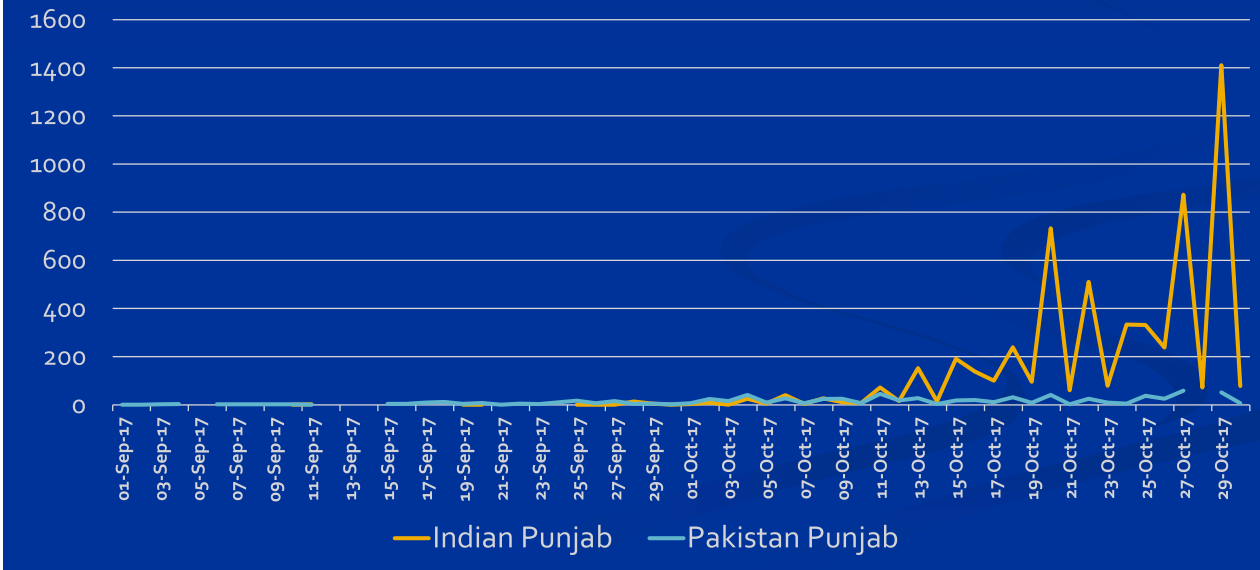
MODIS Fire Alerts-I

Oct-Dec 2017

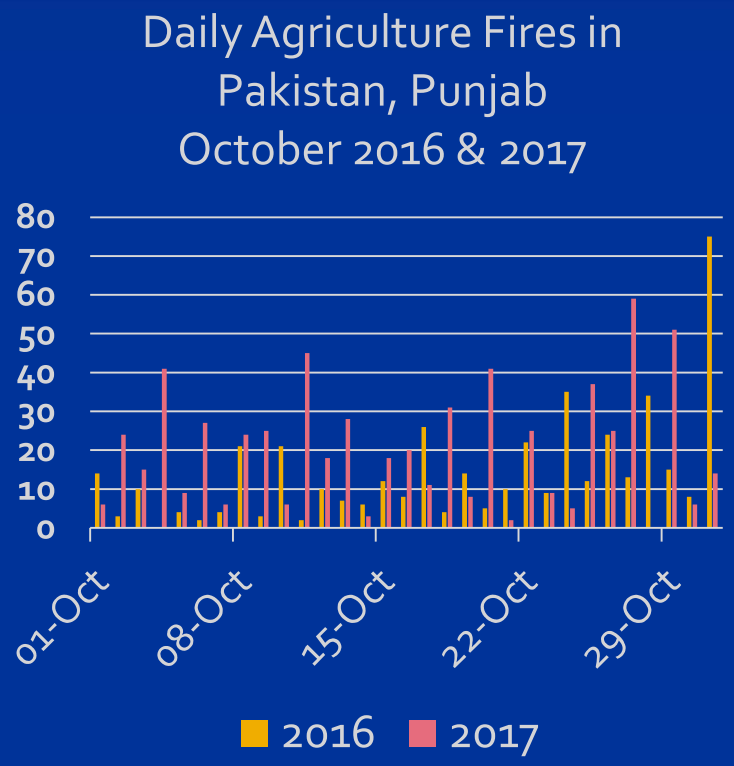


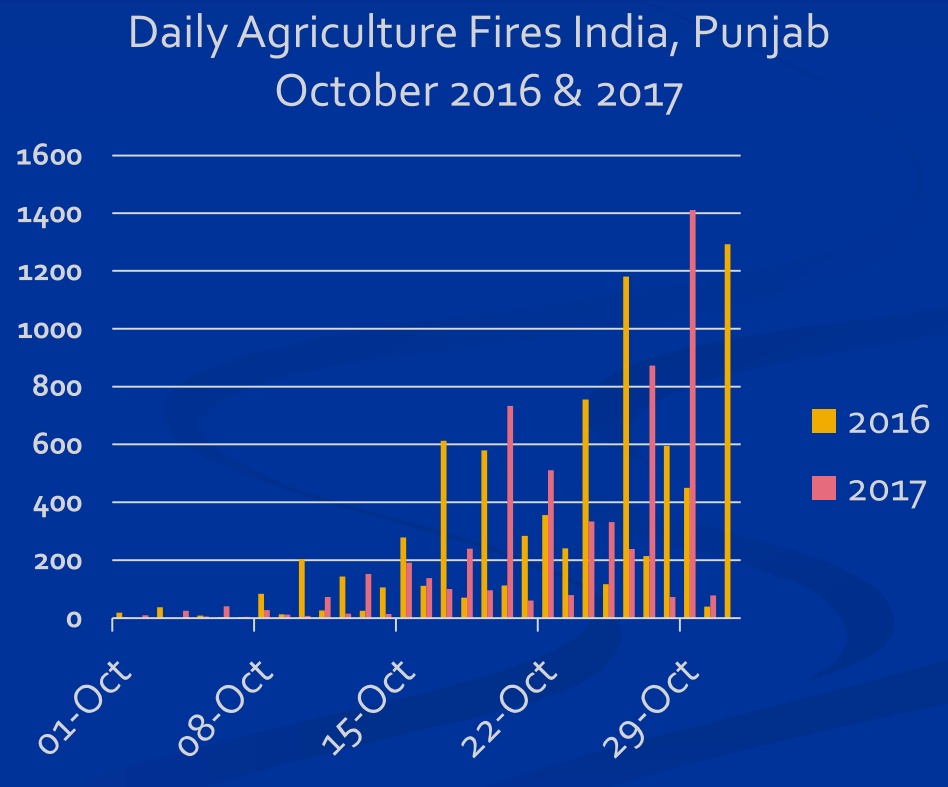
MODIS Fire Alerts-II

Time Line September-October 2017



MODIS Fire Alerts-III

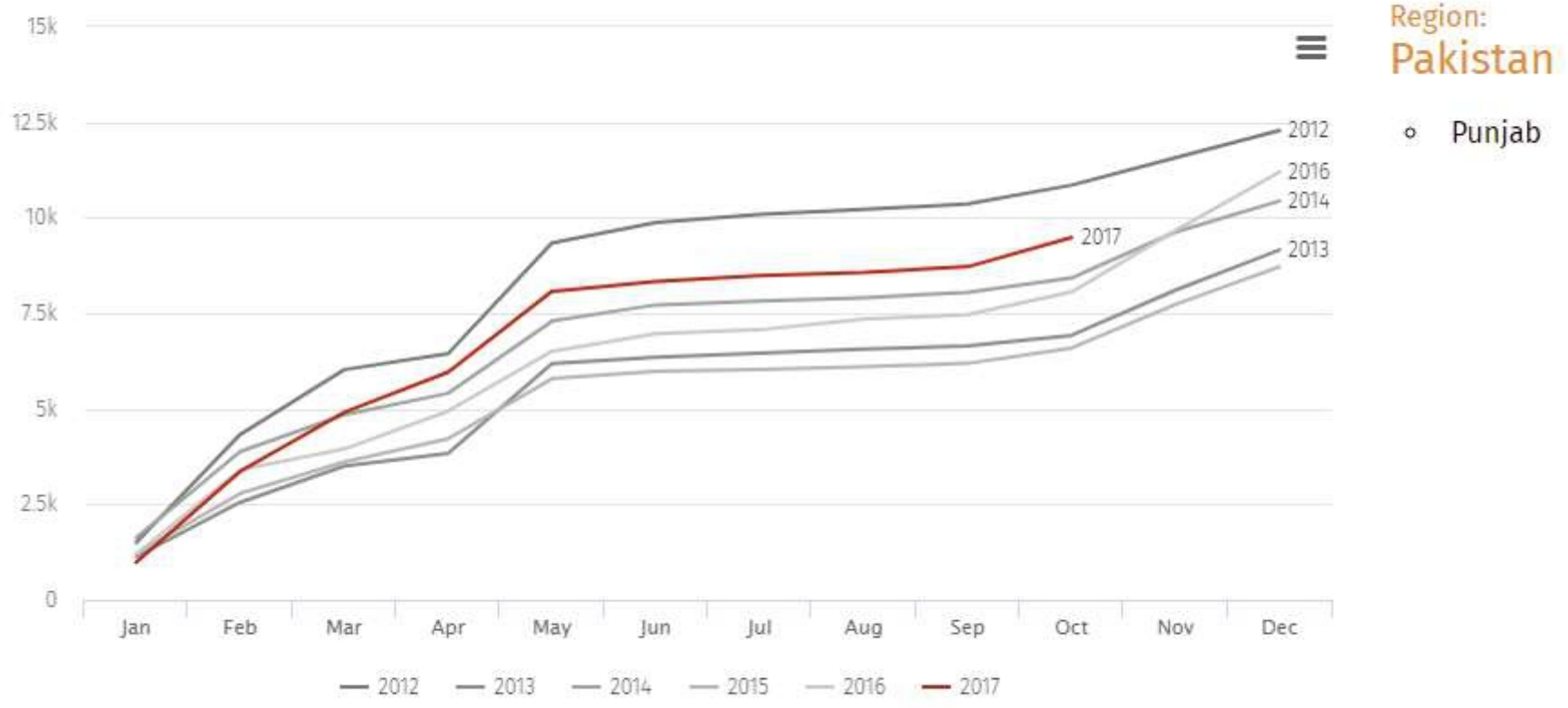




Fire History: Fire Season Progression

2017 MODIS Fire Alerts, Year to Date 9,479

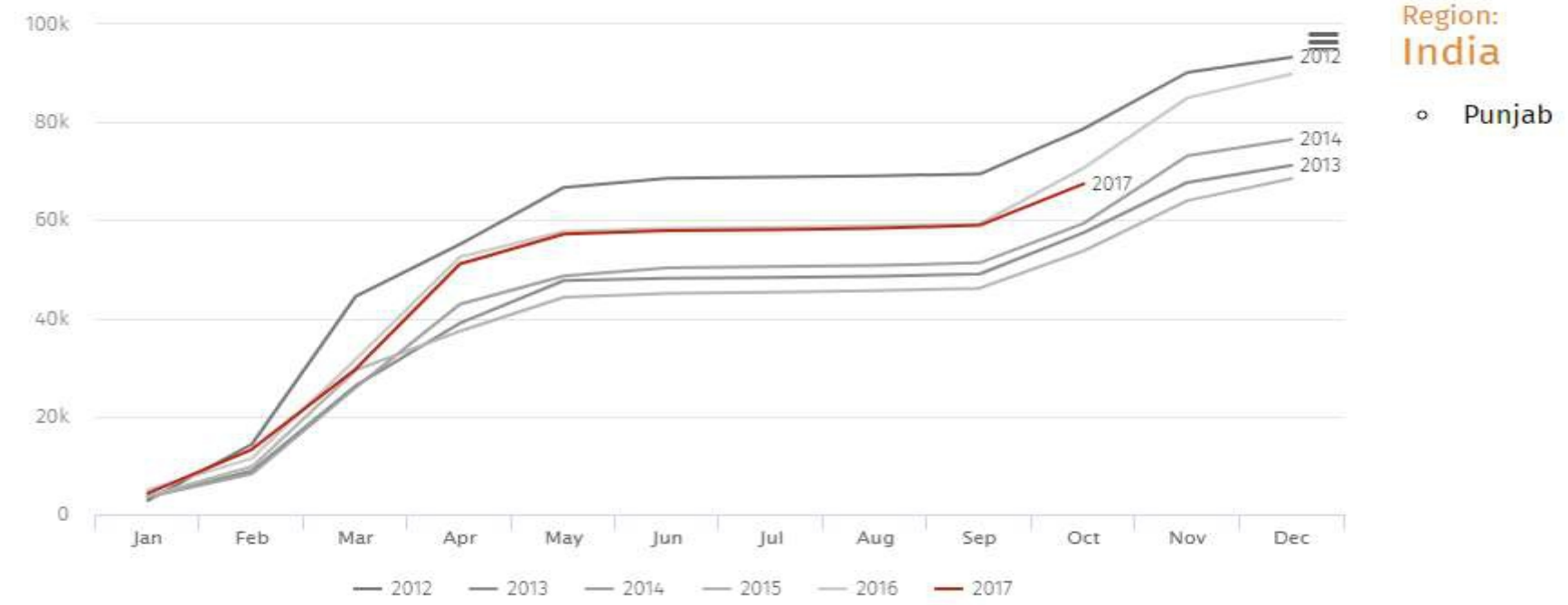
Fire history analyses use MODIS fires data only for 2012 to present.



Annual Fire History

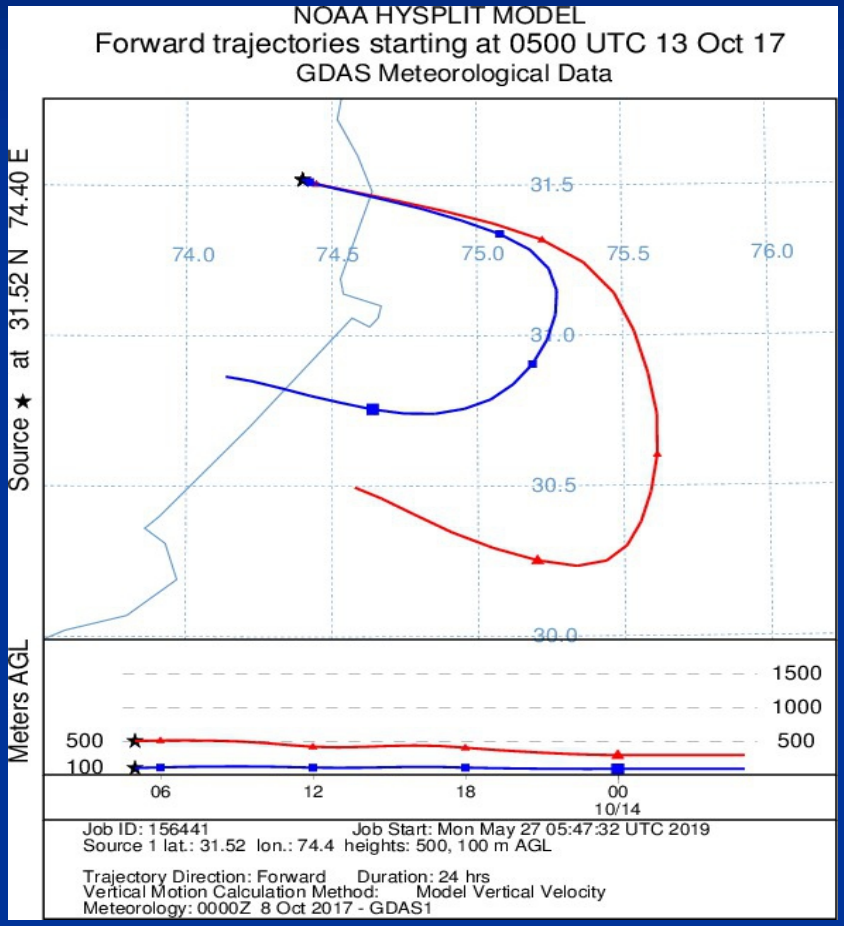
2017 MODIS Fire Alerts, Year to Date 67,454

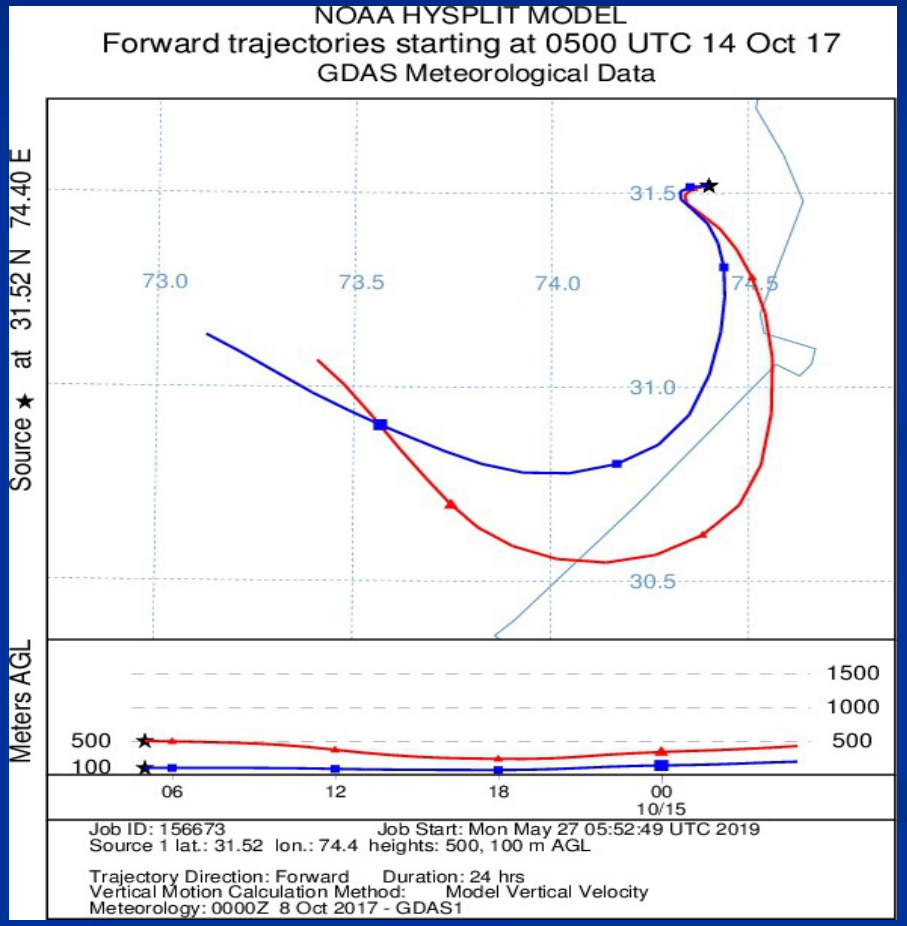
Fire history analyses use MODIS fires data only for 2012 to present.



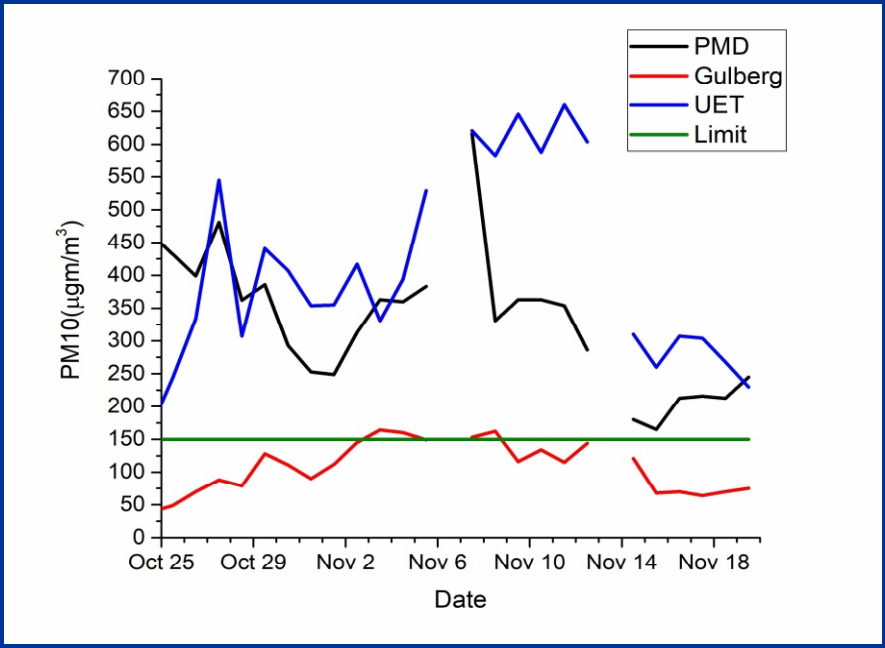
Annual Fire History

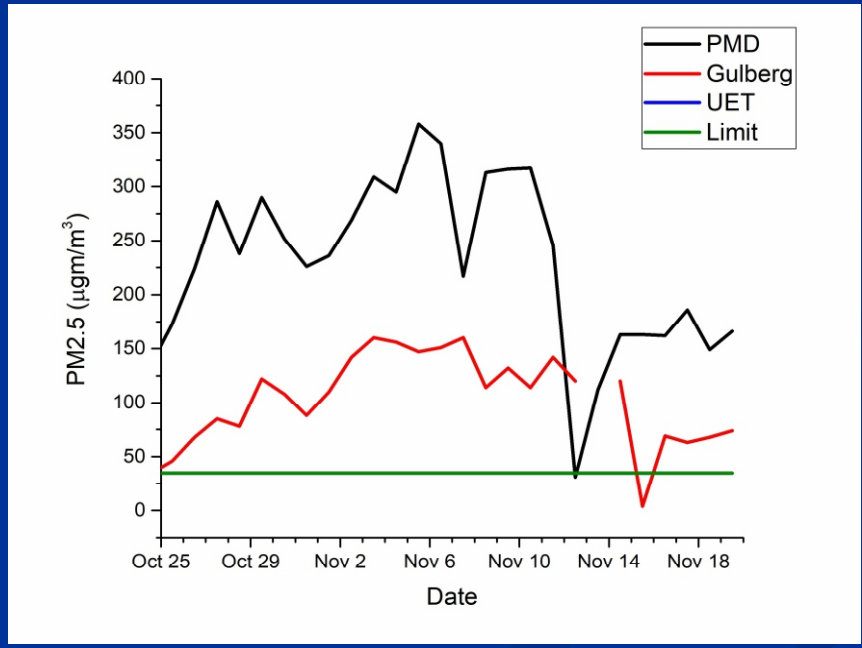
HYSPLIT


NOAA HYSPLIT MODEL
Forward trajectories starting at 0500 UTC 13 Oct 17
GDAS Meteorological Data
Source ★ at 31.52 N 74.40 E
Meters AGL
31.5
31.0
30.5
30.0
74.0
74.5
75.0
75.5
76.0
1500
1000
500
500
100
06
12
18
00
10/14
Job ID: 156441
Job Start: Mon May 27 05:47:32 UTC 2019
Source 1 lat.: 31.52 lon.: 74.4 heights: 500, 100 m AGL
Trajectory Direction: Forward Duration: 24 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 8 Oct 2017 - GDAS1

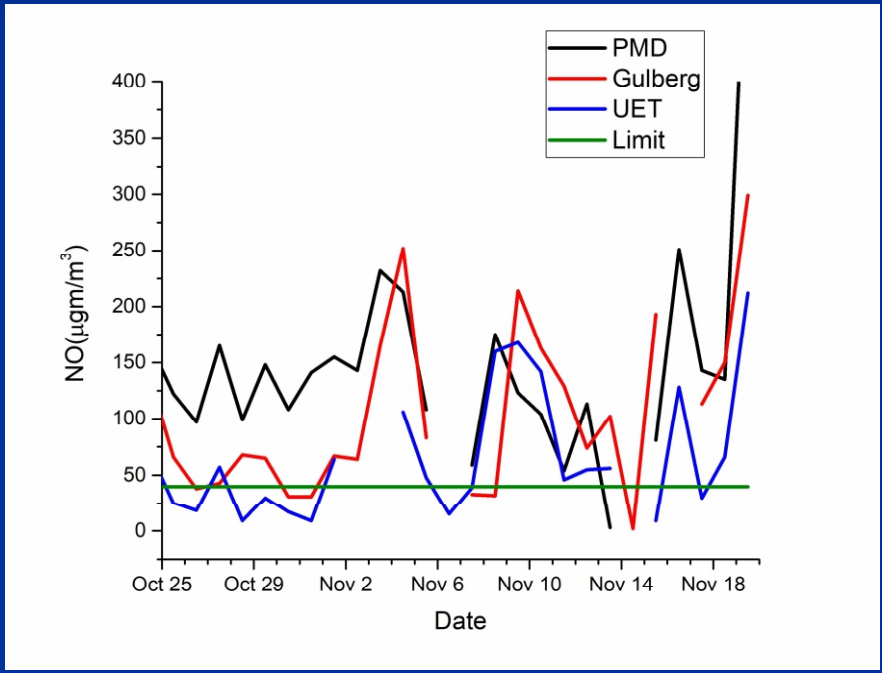

NOAA HYSPLIT MODEL
Forward trajectories starting at 0500 UTC 14 Oct 17
GDAS Meteorological Data
Source ★ at 31.52 N 74.40 E
Meters AGL
31.5
31.0
30.5
73.0
73.5
74.0
74.5
1500
1000
500
500
100
06
12
18
00
10/15
Job ID: 156673
Job Start: Mon May 27 05:52:49 UTC 2019
Source 1 lat.: 31.52 lon.: 74.4 heights: 500, 100 m AGL
Trajectory Direction: Forward Duration: 24 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 8 Oct 2017 - GDAS1

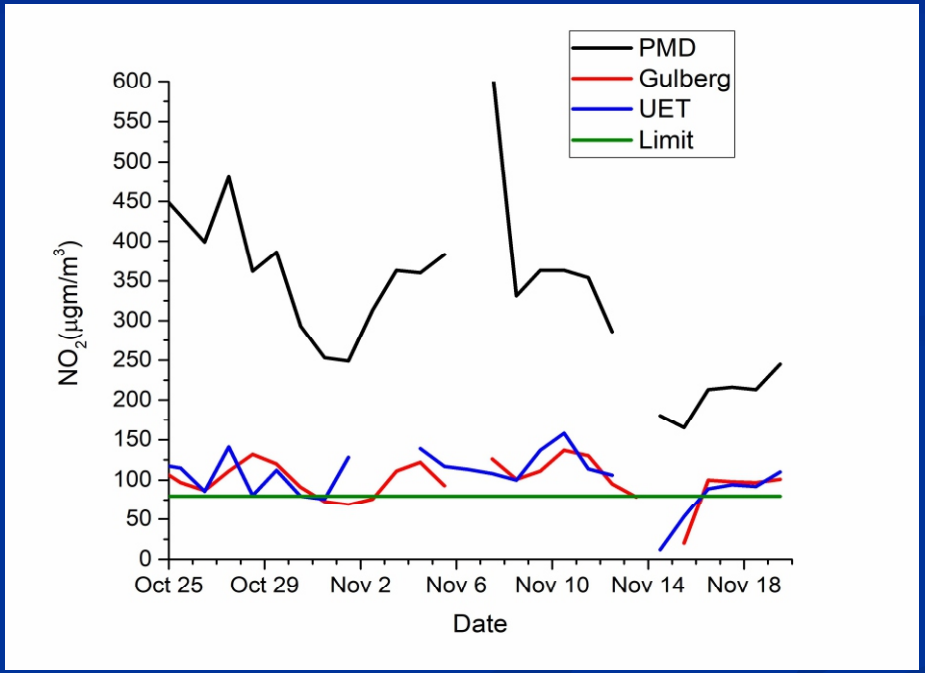
Pollutants during the smog period



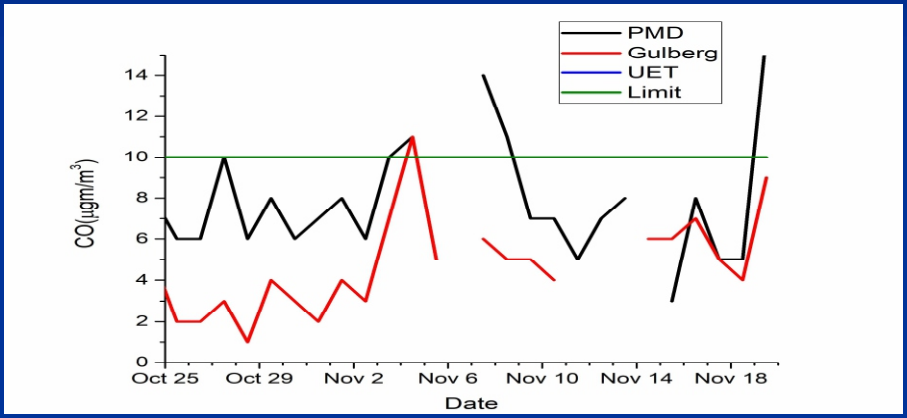


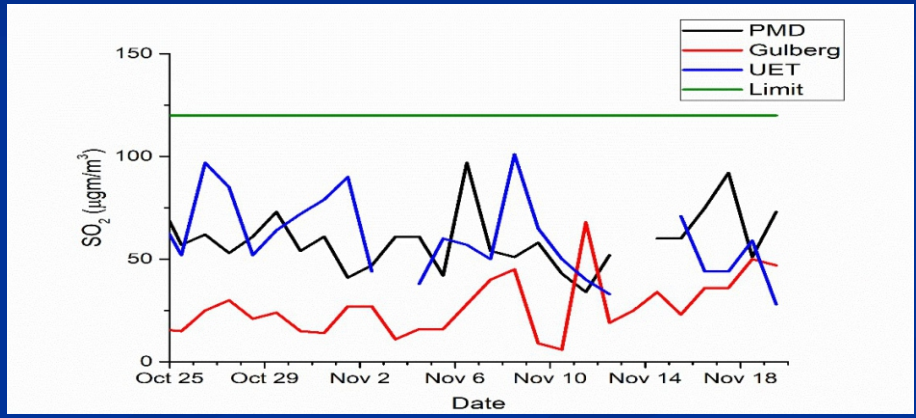
Pollutants during the smog period

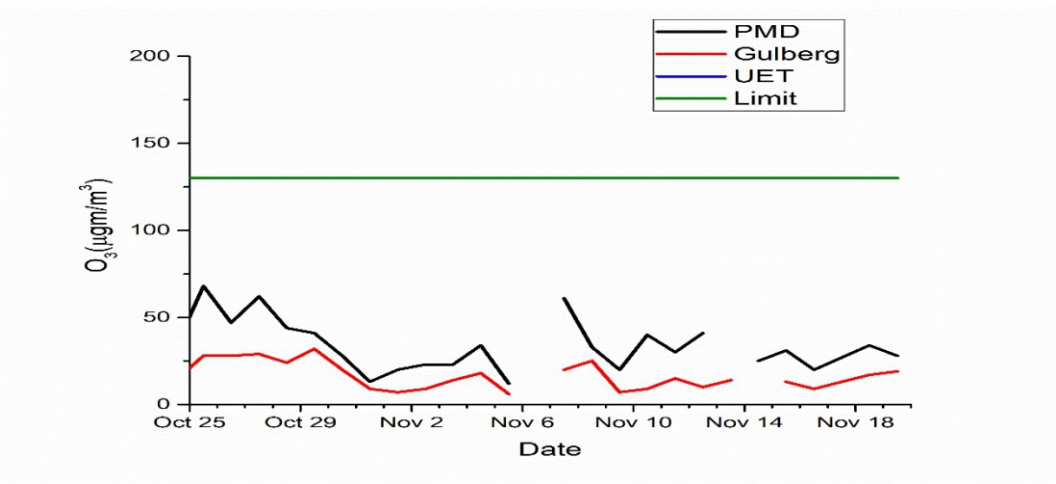




Pollutants during the smog period







Conclusion

- Stubble (rice residue) burning plus other pollutants in the atmosphere is one of the major cause of smog.
- Due to prevailing wind pattern during October and early November the smog/pollutants are transported towards Pakistan from India.
- Inversion layer is formed in October and November because of stability at a low level.
- Transport, industrial emissions and suspension of air pollutants in urban and surrounding region is becoming serious day by day.
- The seasonal shifting or climate change impacts yet need to be determined.

Recommendations

- Changing Vehicle habits
  - Drive less
  - Frequent maintenance
  - Moving to hybrid technology
- Changing consumption habits
  - Avoiding VOC products
  - Energy efficient at home
- Don't support poor environmental practices

Initiatives by the Government

- Clean **Green Pakistan** Programme
- **Zigzag technology** in Brick kiln industry
- Restriction on the industries present in urban areas
- Restricting the movement of vehicles producing pollution

Thank you