EDITOR'S NOTE

Dear Fellow Engineers,

WORLD WATER DAY 2023

"Accelerating Change to Solve the Water and Sanitation Crisis"

Water is essential for all humans, animals, and plants. It plays a critical role in maintaining the balance of ecosystems and is necessary for the survival and well-being of communities worldwide.

As we celebrate World Water Day, we must recognize the importance of water and the need to conserve this precious resource.

Water is used in many ways, including agriculture, industry, and household use. Agriculture accounts for the largest share of water usage globally, as it is required for irrigation to grow crops. In industry, water is used for manufacturing, cooling, and other processes. Water is used for cooking, cleaning, and personal hygiene in households. However, access to clean water is not equal across the globe. Many communities lack clean water and sanitation facilities, especially in developing countries. This disparity has significant consequences for health, hygiene, and economic development.

On World Water Day, it is crucial to raise awareness of these disparities and advocate for solutions that promote equitable access to clean water. The global water crisis is a complex issue affecting millions worldwide. It is a major concern on World Water Day and Save Water Day, as it poses a significant threat to the sustainable development of our planet. The current state of global water resources is alarming.

According to the United Nations, over 2-billion people lack access to clean drinking water, and over 4-billion people experience severe water scarcity for at least one month a year. Furthermore, water contamination is a significant issue, with over 80% of wastewater released into the environment without proper treatment. The global water crisis has multiple causes, including climate change, population growth, and pollution. Climate change is causing changes in rainfall patterns, resulting in water scarcity in some regions and flooding in others. Population growth strains water resources, as more people require water for daily needs. Pollution of water sources, such as rivers and lakes, further exacerbates the crisis, making water unsafe for human use and harming ecosystems.

The impact of the water crisis is significant, affecting people, ecosystems, and economies. Lack of access to clean water leads to the spread of waterborne diseases, causing illness and death.

Ecosystems suffer as water sources are depleted, leading to loss of biodiversity and degradation of habitats. Economies are also affected, as water scarcity can impact agriculture and industry, leading to job losses and economic instability.

Kenya has been experiencing a severe drought, which has had a devastating impact on the country's population and economy. The drought has left millions without clean water, resulting in widespread food insecurity, malnutrition, and displacement. According to the United Nations, over 10 million people in Kenya currently need humanitarian assistance due to the drought. The lack of rainfall has caused crops to fail, leading to food shortages and rising prices. Livestock, a crucial source of income for many families, have died due to a lack of water and grazing areas. As a result, many families have been forced to leave their homes for water and food. The situation in Kenya highlights the importance of addressing water scarcity and promoting sustainable water management practices.

Water conservation refers to any effort to reduce the amount of water wasted or used unnecessarily. It is a critical aspect of water management that helps to ensure that our planet's most precious resource is used wisely and sustainably.

As we celebrate World Water Day and World Water Conservation Day, let's remember the importance of water and take action to protect this precious resource for ourselves and the planet.

In conclusion, water conservation is a critical issue that demands immediate action from all of us. We have highlighted the importance of water, the global water crisis, the role of water conservation, successful water conservation efforts, and what individuals can do to conserve water. The water crisis is urgent, and we must take immediate steps to conserve water and protect our planet's most precious resource.

Let us all work together to make a difference, especially as we commemorate important days such as World Water Conservation Day. Remember, every drop counts!

Chief Editor

Welcome Address

President Pakistan Engineering Congress

World Water Day, 2023
Held on Saturday 25 March, 2023 on the theme of
"Accelerating Change to Solve Water and Sanitation Issues"

Honorable Chief Guest, Engr. Asif Baig sb.

Distinguished Delegates,

Executive Council Members,

Fellow Engineers, Ladies & Gentlemen,

Assalam-o-Alaikum!

It is a matter of great honor and pleasure for me to welcome you all over here on the World Water Day 2023. Pakistan Engineering Congress has been Commemorating World Water Day on the universally selected themes since 2005. The theme for this year is "Accelerating Change." It calls for the sustainable management of water resources, the promotion of water conservation, and the protection of water resources as well as sanitation issues.

Ladies & Gentlemen!

Water is essential to all life on Earth, and access to clean water and sanitation facilities is a fundamental human right. Yet, despite the progress made over the years, the water and sanitation crisis continues to affect millions of people worldwide. According to the United Nations, 2.2 billion people lack access to safe drinking water, and 4.2 billion people lack access to adequate sanitation facilities.

The water and sanitation crisis has devastating effects on human health, education, and economic development. Waterborne diseases such as cholera, typhoid, and dysentery are responsible for more than 3.4 million deaths each year, mostly among children under the age of five.

- 1.4 million people die annually and 74 million will have their lives shortened by diseases related to poor water, sanitation and hygiene. (WHO 2022)
- Today, 1 in 4 people – 2 billion people worldwide – lack safe drinking water. (WHO/UNICEF 2021)
- Almost half of the global population – 3.6 billion people – lack safe sanitation. (WHO/UNICEF 2021)
- Globally, 44 per cent of household wastewater is not safely treated. (UN-Water 2021)

- Global water demand (in water withdrawals) is projected to increase by 55 per cent by 2050. (OECD 2012) Organization for Economic Cooperation and Development

Water affects everyone, so we need everyone to take action.

The water and sanitation crisis also has economic implications. The lack of access to clean water and sanitation facilities reduces productivity and increases healthcare costs. Therefore, accelerating change to solve the water and sanitation crisis is not only a moral imperative but also an economic necessity.

Ladies & Gentlemen!

To accelerate change and address the water and sanitation crisis, we must first increase funding for water and sanitation programmes. Despite the economic advantages of investing in water and sanitation, funding for these programmes is still insufficient. According to the World Bank, the annual financing gap for water and sanitation infrastructure in developing countries is estimated to be $114 billion.

To bridge this financing gap, we need to mobilize more resources from both the public and private sectors. Governments must increase their budget allocations for water and sanitation programs, and international donors must fulfill their commitments to provide financial assistance to developing countries.

At the same time, we need to leverage the private sector's resources and expertise to accelerate progress. Private sector investment can play a significant role in water and sanitation infrastructure development, including through public-private partnerships, microfinance schemes, and innovative financing mechanisms.

To accelerate progress, we need to adopt a more integrated approach to water and sanitation management. This means recognizing that water and sanitation are interconnected, and that interventions in one area can have significant impacts on the other.

Integrated water resource management is an approach that recognizes the interdependencies between water resources and their management, including the social, economic, and environmental aspects. It involves coordinating different sectors, such as agriculture, energy, and health, to ensure the sustainable and equitable use of water resources.

Third, we need to leverage technology to accelerate progress. Technology has the potential to revolutionize the water and sanitation sector, making services more accessible, efficient, and affordable.

For example, mobile technology can be used to collect real-time data on water quality, usage, and availability. This data can be used to inform decision-making and improve water service delivery.

Smart water meters can also be used to monitor water usage, identify leaks, and reduce water loss. This can help to improve the efficiency of water service delivery and reduce costs.

Ladies & Gentlemen!

There is a need to strengthen governance and institutions to ensure the sustainability of water and sanitation interventions. Governance and institutional weaknesses have been identified as one of the main barriers to progress in the water and sanitation sector.

To address these weaknesses, we need to strengthen the capacity of institutions responsible for water and sanitation management. This includes providing training and technical assistance to government agencies, civil society organizations, and private sector.

In conclusion, valuing water is not just about recognizing its importance, but also taking action to protect and conserve it. This World Water Day, let us all pledge to do our part in preserving this precious resource and ensuring that everyone has access to clean water.

Thank you.

World Water Day, 2023
Held on March 25, 2023 on the theme of
"Accelerating Change to Solve Water and Sanitation Issues"

This year the Theme is "Accelerating the Change" as elucidated below:

This World Water Day is about accelerating change to solve the Water and Sanitation crises. And because water affects us all, we need everyone to take action. You and your family, school and community can make a difference by changing the way you use, consume, and manage water in your lives. Your commitments will be added to the Water Action Agenda, to be launched at the UN 2023 Water Conference – the first event of its kind for nearly 50 years. This is a once-in-a-generation moment for the world to unite around water.

LEARN

Right now, we are seriously off-track to meet Sustainable Development Goal (SDG) 6 water and sanitation for all by 2030. Billions of People and countless schools, businesses, healthcare centers, farms and factories don't have the safe water and toilets they need. To accelerate change, we need more action, including from individuals like you. Pakistan Engineering Congress assembled a galaxy of Water conservation and Water application experts. Seven papers were presented as under:

- "SUSTAINABLE MANAGEMENT OF RAINWATER RECHARGE GROUNDWATER IN CITY LAHORE"
- "ACCELETATING THE CHANGE THROUGH IWRM AT KOTRI BARRAGE COMMAND AREA"
- "ROLE OF DIGITAL TECNOLOGY IN RESOLVING THE LONG-LASTING DISPUTES"
- "CAUSES OF 2022 FLOODS, RECOMMENDATIONS FOR EARLY REHABILITATION & RECOMMENDATIONS TO AVOID MAJOR DEVASTATION IN FUTURE"
- "PRESERVATION OF COASTAL AND MARINE ECOSYSTEM"
- "MEASURES TO ADDRESS WATER SCARCITY ISSUES OF PAKISTAN"
- "AN ACCELETATED CHANGE FOR THE REDUCTION OF DOMESTIC WASTE WATER BY ADOPTING DETERGENT FREE OZONE BASED LAUNDRY SYSTEM"

Engr. Mirza Asif Baig, a renowned Environmentalist was the Chief Guest. After presentation of the papers a lively Questions Answers session ensued. After concluding remarks by the Chief Guest, shields of Pakistan Engineering Congress were conferred on the speakers.

WORLD WATER DAY 2023 HELD ON SATURDAY MARCH 25, 2023 ON THE THEME OF "ACCELERATING CHANGE TO SOLVE WATER & SANITATION CRISIS"



Engr. Najam Waheed President-PEC with Engr. Dr. Muhammad Riaz Member Executive Council, Engr. Muhammad Ammar Publicity Secretary-PEC, Welcoming to Chief Guest Engr. Mirza Asif Baig



Engr. Muhammad Ammar Member Executive Council Conducting the Proceedings



Engr. Najam Waheed President-PEC Presenting Welcome Address at the event



(From Left) Engr. Ch. Ghulam Hussain Former President-PEC, Chief Guest Engr. Mirza Asif Baig, Engr. Najam Waheed President-PEC, Engr. Muhammad Ammar Publicity Secretary-PEC.



Ms. Amara Tahir presenting her paper on the Topic of “Sustainable Management of Rainwater to Recharge Groundwater in City Lahore”



Engr. Mahmood Akhtar Cheema Presenting his paper on the Topic of “Preservation of Coastal and Marine Ecosystem”



Engr. Muhammad Ejaz Tanveer Presenting his paper on the Topic of “Measures to Address Water Scarcity Issues of Pakistan”

GLIMPSES OF AUDIENCES





GLIMPSES OF AUDIENCES





QUESTIONS / ANSWERS SESSION



Engr. Muhammad Sulaiman Khan in a dialogue with a Speaker



Engr. Amjad Saeed Former President-PEC and the principal author of the paper on the topic of “Role of Digital Technology in Resolving the Long Lasting Disputes” Answering Questions pertaining to Issues raised in the paper.



Chief Guest Engr. Mirza Asif Baig delivering Concluding Remarks at the event



(From Left) Engr. Ch. Ghulam Hussain Former President-PEC, Engr. Mirza Asif Baig Chief Guest and Engr. Najam Waheed President-PEC presenting Congress Shield to Mr. Ahsan Latif for Presenting his paper on the Topic of “Accelerating the Change Through IWRM at Korti Barrage Command Area”



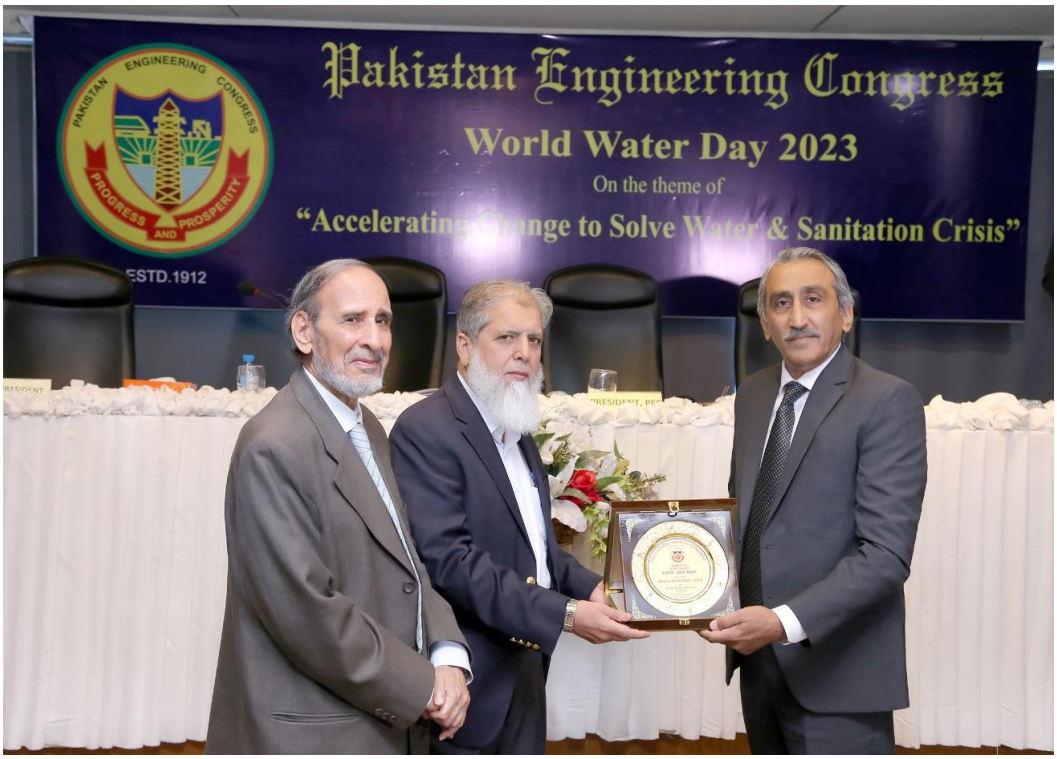
(From Left) Engr. Ch. Ghulam Hussain Former President-PEC, Engr. Mirza Asif Baig Chief Guest and Engr. Najam Waheed President-PEC presenting Congress Shield to Engr. Dr. Muhammad Riaz for this paper on "Role of Digital Technology in Resolving the Long-Lasting Disputes"



(From Left) Engr. Ch. Ghulam Hussain Former President-PEC, Engr. Mirza Asif Baig Chief Guest and Engr. Najam Waheed President-PEC presenting Congress Shield to Engr. Muhammad Mohsin Munir for his paper on "Causes of 2022 Floods, Recommendations for Early Rehabilitation & Recommendations to Avoid Major Devastation in Future"



(From Left) Engr. Ch. Ghulam Hussain Former President-PEC, Engr. Mirza Asif Baig Chief Guest and Engr. Najam Waheed President-PEC presenting Congress Shield to Ms. Siam Khalid for her paper on "An Accelerated Change for the Reduction of Domestic Wastewater by Adopting Detergent free Ozone Based Laundry System"



Engr. Ch. Ghulam Hussain Former President-PEC and Engr. Najam Waheed President-PEC presenting Congress Shield to Chief Guest Engr. Mirza Asif Baig

WELCOME ADDRESS

President Pakistan Engineering Congress
Seminar on "Road Asset Management System"
Held on February 21st, 2023

Honorable Chief Guest, Dr. Muhammad Abid Bodla Sb.

Distinguished Delegates,

Executive Council Members,

Fellow Engineers, Ladies & Gentlemen,

Assalam-o-Alaikum!

It is a matter of great honor and pleasure for me to welcome you all over here on the seminar on Road Asset Management System arranged by Pakistan Engineering Congress.

Ladies & Gentlemen!

The Road Asset Management System (RAMS) is a process that identifies and quantifies the performance status of road network in a manner such that a database can be established. Careful planning and coordination of local public infrastructure is fundamental to the economic and social well-being of any country. In order to preserve the asset, one has to be aware of the quantity and quality of the asset at any moment of time. To preserve the road asset or to minimize the rate of deterioration, the assets are needed to be monitored regularly and the pavement health, therefore, needs to be updated regularly in a system. Also, proper model should be present to predict the pavement condition or traffic growth. This is to ensure that the road infrastructure is adequate as well as potent enough to cater the needs of the future traffic. If not, the required up-gradation to tackle the situation and budget required for the same should be computed beforehand. But, the road sector in most of the developing countries have critical 'information gaps' in their overall planning process, including asset management systems. Thus, maintaining the asset becomes a herculean task. Proper Road Asset Management System (RAMS) helps to get rid of this problem. "You cannot manage, if you don't know what you own", the same is applicable to road infrastructure too.

Ladies & Gentlemen!

Punjab has a road network of almost 38,000 km, and implementing improvement and maintenance works on this vast network on the basis of the judgement of the engineers is vital, considering the huge amount of taxpayers' money involved. Moreover, political considerations influence the process of shortlisting of roads for improvement works. RAMS eliminates such confusions and helps the concerned authority to prepare a list of road sections for improvement works purely on the basis of their pavement or traffic conditions. Moreover, the list can be prepared for the next 5-10 years, if the model is calibrated well enough with the condition of the roads of

that particular region. The budget is computed beforehand, and hence proper groundwork can be done to ensure the availability of the same.

Ladies & Gentlemen!

The Road asset Management System has a good scope in developing countries as it helps to not only quantify the assets but also to preserve the same by incorporating appropriate measures at appropriate times. But a major change in the way of managing the things right from data collection to preparation of budgets is essential. The success of RAMS depends fully on regular updating of the road asset details. As it is said, “A stitch in time saves nine”. The same can be translated to pavement engineering terms as, “Proper road maintenance during construction period saves both time and money in post-construction maintenance”.

Ladies and Gentlemen!

I believe that when learned speakers present their papers today, we will not only be wiser than before, but we will also be able to formulate strategies for implementing asset management practices and programmes in the Departments for the improvement of the road network that the road users expect and deserve.

SEMINAR FOR STRENGTHENING ROAD MANAGEMENT SYSTEM HELD ON TUESDAY 21ST FEBRUARY 2023 AT MASHHADI HALL PAKISTAN ENGINEERING CONGRESS HQ

The seminar was held in collaboration with Communication & Works Department of Punjab to discuss way-out to chronic problems related to the maintenance of Roads, Pavements & Bridges arising out of limited budget, lack of appropriate technologies and priorities in the backdrop of the following.

"The Government of Punjab requested to the Japan International Cooperation Agency (JICA) to launch a technical assistance project, the ***Project for Strengthening of Road Asset Management System in Punjab Province,*** with the aim of improving technical capabilities related to maintenance and management of roads and bridges in C&W in Punjab Province. C&W Department shall work in cooperation with JICA, to achieve the Project Outputs (5 Outputs). The overall goal of the project is to be maintained and managed the Punjab's roads and bridges, based on appropriate prioritization. Simple Pavement Management System (PMS) and Simple Bridge Management System (BMS) will be developed by the JICA expert team, by customizing the application according to the Counterpart (C/P, C&W) requirement. CWD shall be providing necessary field data. Operation and maintenance of the equipment provided by JICA for the Project. C&W will bear the running expenses for the Project implementation along with provision of the office furniture and utilities. The Project Director (Secretary) and Project Manager (Chief Engineer) are from the C&W Department".

Six papers were presented on the undermentioned topics by "Domestic" and "Foreign" specialists with lifelong knowledge, vast experience of maintenance of Road, Bridges and pavements and its relevant dimensions.

I. "Road Asset Management System (RAMS) & Fast Falling Weight Deflectometer (FFWD)".
II. "Selection of Alternatives Using Different Analysis Methodologies".
III. "Road Asset Management System (RAMS) in National Highway Authority (NHA)".
IV. "Pavement Management System (PMS), Case Studies in Japan & Prevention of Pavement Damage Including Rutting".
V. "Bridge Management System (bms) IN Japan & Communication and Works Department (C&W)".
VI. "Project for Strengthening of Road Asset Management System in Punjab Province".

A lively questions and answers session took place with the speakers. The Chief Guest was Engr. Dr. Abid Bodla, Member Infrastructure Board (P&B) Punjab who delivered Concluding Remarks. Pakistan Engineering Congress shields were conferred on the speakers. It was a highly attended event.

Seminar on "Road Asset Management held on 21st February 2023



(From Left) Chief Guest Engr. Dr. Muhammad Abid Bodla being Welcomed by Engr.Najam Waheed President-PEC, Engr. Nayyar Saeed Secretary-PEC, Mr. Imran Arshad Manager Admin-PEC



(From Left) Engr. Nayyar Saeed Secretary-PEC, Chief Guest Engr. Dr. Muhammad Abid Bodla, Engr. Najam Waheed President-PEC, Engr. Muhammad Ammar Publicity Secretary-PEC



Engr. Najam Waheed President-PEC presenting Welcome Address



Group Photo of Speakers



Chief Guest Engr. Dr. Muhammad Abid Bodla Member Infrastructure Depertment (P&D) Govt. of Punjab making Concluding Remarks at the Symposium



(From Right) Engr. Dr. Muhammad Abid Bodla and Engr. Najam Waheed President-PEC Presenting Congress Shield to Engr. Nayyar Saeed Secretary-PEC, for Presenting his paper on the topic of "Road Asset Management System (RAMS) & Fast Falling Weight Deflectometer (FFWD)"



(From Left) Engr. Nayyar Saeed Secretary-PEC, Engr. Najam Waheed President-PEC, and Chief Guest Engr. Dr. Muhammad Abid Bodla Presenting Congress Shield to Dr. Muhammad Waseem Mirza for presenting his Paper on the Topic of "Selection of Alternatives Using Different Analysis Methodologies"



(From Left) Engr. Nayyar Saeed Secretary-PEC, Engr. Najam Waheed President-PEC, and Chief Guest Engr. Dr. Muhammad Abid Bodla presenting Congress Shield to Mr. Satoshi MIZUNO for presenting his Paper on the Topic of "Pavement Management System (PMS), Case Studies in Japan & Prevention of Pavement Damage Including Rutting"



(From Left) Engr. Nayyar Saeed Secretary-PEC, Engr. Najam Waheed President-PEC, and Chief Guest Engr. Dr. Muhammad Abid Bodla presenting Congress Shield to Mr. Yukio IGO for Presenting his Paper on the Topic of "Bridge Management System (BMS), in Japan & Communication and Works Department (C&W)"



(From Left) Engr. Nayyar Saeed Secretary-PEC, Engr. Najam Waheed President-PEC, and Chief Guest Engr. Dr. Muhammad Abid Bodla presenting Congress Shield to Dr. Imran Khan for his Paper on the Topic of "Project for Strengthening of Road Asset Management System in Punjab Province"



(From Right) Engr. Najam Waheed President-PEC Presenting Congress Shield to Special Guest Engr. Rana Muhammad Dawood



Engr. Nayyar Saeed Secretary-PEC and Engr. Najam Waheed President-PEC presenting Congress Shield to Chief Guest Engr. Dr. Muhammad Abid Bodla

Glimpses of Audiences





Glimpses of Audiences





Questions / Answers Session



Engr. Amir Yaqoob in conversation with the Speaker



Engr. Ch. Ghulam Hussain Former President-PEC in conversation with the Speaker

Questions / Answers Session



Chief Guest Engr. Dr. Muhammad Abid Bodla discussing issues raised by the Speaker in the Presentation



Engr. Sabir Hassan seeking clarification of some point with the Speaker.

Questions / Answers Session



Dr. Nazakat Ali in Conversation with a Speaker



Engr. Shahzad Hashim in conversation with the Speaker

TECHNICAL VISIT OF SUNDER INDUSTRIAL ESTATE, LAHORE ON FEBRUARY 8, 2023

1. A Delegation of Pakistan Engineering Congress led by Engr. Anwar Qaseem Qureshi, Joint Secretary, PEC along-with Engr. Dr. Muhammad Riaz, Member Executive Council. Paid a Technical Visit to Sunder Industrial Estate on 8.2.2023. The Delegation was Welcomed by Mr. Ahmad Khan, President Board of Management of Sunder Industrial Estate and Mr. Zain Mirza, Secretary of the Board and Mr. Muhammad Arif, Senior Estate Manager. The Delegation was apprised on the Role of Industrial Estates in the economic Development of the Country. The Delegation was also taken around the various Departments of the Estate:

- Communication Department.
- Fire Fighting/Security System.
- Grid Station
- Industrial Safety Unit.

2. At the conclusion of the visit, Engr. M.A, Qaseem Qureshi, Joint Secretary, and Engr. Dr. Muhammad Riaz presented congress memento to Mr. Ahmad Khan, President of the Estate. Mr. Ahmad Khan, President of Industrial Estate also presented Souvenir of Sunder Industrial Estate to the Joint Secretary of Pakistan Engineering Congress. Congress Publications were also presented to the Secretary/Senior Estate Manager. It was a very fruitful; visit. The visit was arranged by Mr. Mohsin M. Syed former President of the Sunder Estate.

Technical Visit of Sundar Industrial Estate Lahore on 8-02-2023



President of Sundar Industrial Estate Mr. Ahmad Khan Welcoming the Delegation of Pakistan Engineering Congress



Introductionry Remarks by Mr. Mohsin M. Syed Former President Board Of Management Sundar Industrial Estate to Delegation of Pakistan Engineering Congress



An other photo of the Delegation



Mr. Ahmad Khan President of the Sundar Industrial Estate Briefing the Delegation on the Role of Industrial Estates



Delegation Leaders Engr. M. Anwar Qaseem Qureshi Honry. Joint Secretary PEC, Engr. Dr. Muhammad Riaz Member Executive Council Presenting the Congress Souvenir to President Mr. Ahmad Khan President Board Of Management Sundar Industrial Estate



Engr. Dr. Muhammad Riaz Member Executive Council Presenting Congress Publications to Secretary Board Of Management Sundar Industrial Estate Mr. Zain Mirza



Engr. Dr. Muhammad Riaz Member Executive Council Presenting Congress Publications to Mr. Muhammad Arif Secretary of Management Board.



Mr. Ahmad Khan President Board Of Management Sundar Industrial Estate Presenting a Souvenir to Delegation Leaders Engr. M. Anwar Qaseem Qureshi Honry. Joint Secretary PEC, Engr. Dr. Muhammad Riaz Member Executive Council



Group Photo



Engr. M. Anwar Qaseem Qureshi Honry. Joint Secretary PEC Recording his Comments in Guest Book of Board Of Management Sundar Industrial Estate



Engr. Dr. Muhammad Riaz Member Executive Council PEC Recording his Comments in Guest Book of BOMSIE



Group Photo

DASU HYDROPOWER PROJECT

General:

- Being constructed on River Indus 7 Kilometer (Km) upstream of Dasu Town in Upper Kohistan District of Khyber Pakhtunkhwa (KP) Province.
- Total installed capacity of the project stands at 4320 MW.
- The project is being implemented in two phases i.e. Stage-I and Stage-II, 2160 MW each.
- At present, Stage-I is being constructed with approved cost of Rs. 511 billion.
- Stage-I of Dasu Hydropower Project to start electricity generation in 2026

Progress:

- Despite Covid-19 pandemic and recent floods, construction work on the project is continuing by putting in place strict preventive measures at project sites.
- Work is in progress simultaneously on 13 different sites:
  - **Main Works - 8 Sites:**
    1. Diversion Tunnels
    2. Starter Dam
    3. Power House Cavern
    4. Transformer Cavern
    5. Flushing/Traffic Tunnel on Left Bank
    6. Main Switch Yard
    7. Intake Structure
    8. Cable Crane platform at Right Bank
  - **Preparatory Works - 5 Sites:**
    1. Project Colony
    2. Relocation of Karakorum Highway (KKH)
    3. 132 KV Transmission Line from Duber Hydel Power Station to Dasu
    4. Right Bank Access Roads
    5. Resettlement Villages

Financial Arrangements:

- WAPDA has been implementing Stage-I of the project by applying an innovative financial strategy and leveraging its financial strength with no fiscal burden on national exchequer.
- The project is being funded by WAPDA and the World Bank:
  - WAPDA Financing Rs. 409 billion (80%)
  - World Bank Financing Rs. 102 billion (20%)

  Total Rs. 511 billion

Salient Features:

- Dam Type — Roller Compacted Concrete (RCC)
- Dam Height — 242 Meter (m)
  (61 m higher than Three Gorges Dam in China and 21m higher than Hoover Dam in US)
- Power House — Underground on Left Bank
- No. of Power Generating Units — 12 (360 MW/Unit)
  - Stage-I — 6 units
  - Stage-II — 6 units

Benefits:

- On completion of both Stage-I and II, Dasu will be the project with highest annual energy generation in Pakistan i.e. 21 billion units per annum
  - Stage-I: 12 billion units per annum
  - Stage-II: 9 billion units per annum
- Confidence Building Measures (CBMs) amounting to Rs. 17.34 billion being implemented in the project area:
  - Resettlement Development — Rs. 8.93 billion
  - Social Development — Rs. 2.85 billion
  - Environment Management — Rs. 5.56 billion
- Job Opportunities:
  - Current Working Strength — 5329
    - Locals: 2664
    - Non Locals: 2069
    - Foreigners 596
  - Demand during Peak Activities 8000
- The project to stabilize the economy of Pakistan by providing low-cost hydel electricity besides triggering a new era of socio-economic development in the far-flung areas of KP Province
- Indus Diverted to Dasu Project

INDUS DIVERTED TO DASU PROJECT

By:

Zafar Bhutta

Stage-I of the project likely to start electricity generation in 2026

Indus River was successfully diverted following the completion of one of the two diversion tunnels at the under-construction Dasu hydropower project in Kohistan District, Khyber-Pakhtunkhwa (K-P).

Instead of its natural course, the river is now flowing through a 1.33-kilometre (Km) long diversion tunnel with a 20-metre (m) width and 23-m height.

Consequently, construction activities have been initiated on the starter dam, leading toward the construction of the main dam of the Dasu hydropower project.

The diversion of the mighty river was witnessed by the general manager and project director of the project, representatives of contractors and consultants, along with a number of engineers and workers.

Meanwhile, Water and Power Development Authority (Wapda) Chairman Lt General (retd) Sajjad Ghani congratulated the project management on achieving this milestone.

The diversion system of the Dasu hydropower project comprises two tunnels – tunnel A and tunnel B. Of these, the latter is complete, which has the discharge capacity, sufficient to divert the water from Indus River during the current lean-flows season.

The 1.5-km long tunnel A, with a 20-m width and 23-m height, will also be ready by mid-April this year to cater to the increased water flows during the high-flow season.

The project is a vital component of the least-cost, green and clean energy generation plan of WAPDA.

The 4320 MW-Dasu hydropower project is planned to be completed in two stages.

At present, WAPDA is constructing its stage-I with an installed generation capacity of 2160 MW and annual energy generation of 12 billion units and is likely to start electricity generation in 2026.

The 2160 MW stage-II, when implemented, will also provide nine billion units to the national grid.

On the completion of both stages, Dasu will become a project with the highest annual energy generation in Pakistan (ie 21 billion units per annum on average).

TECHNICAL VISIT OF PAKISTAN ENGINEERING CONGRESS DELEGATION TO TARBELA DAM T-4 & T-5 TUNNEL PROJECTS ON 11-01-2023

1. Tarbela Dam Features

The project consists of a 9,000 feet (2,743 meters) long, 470 feet (143 meters) high (above the river bed) earth and rock-fill embankment across the entire width of the river with two spillways cutting through the left bank and discharging into a side valley, its main spillway has a discharge capacity of 650,000 cusecs (18,406 cumecs), and auxiliary spillway 850,000 cusecs (24,070 cumecs), two auxiliary embankment dams close the low level ridges in the left bank valley. A group of 4 - tunnels, each about half a mile long through the right abutment rock, have been constructed for irrigation releases and power generation. During the construction operations, these tunnels were used initially for river diversion. Irrigation tunnel 5 situated on the left bank, for which NESPAK were the Project Consultants, was put into operation in April 1976.

2. Tunnels

The four tunnels (low level outlets), each about half a mile long, through the right abutment initially served for the diversion of water during the final phases of construction of the Project. Now Tunnels 1, 2, 3 and 4 are being used for power generation, while planned to install power units on Tunnel No.-5. The discharge capacity of irrigation tunnel at higher reservoir elevation (1, 500 ft) is 93,000 cusecs (2,634 cumecs). A fifth tunnel on the left bank designed to augment irrigation releases upto 86,000 cusecs (2,435 cumecs) at high reservoir level has also been added to the project.

3. Power Generation

According to the original plan, four power units of 175 MW generating capacity each were to be installed on each of the tunnels 1, 2 and 3 with the ultimate installed capacity of 2,100 MW. Of these four units on Tunnel -1 were commissioned in year 1977. Due to increasing prices of the fossil fuel, the Government of Pakistan has been laying greater emphasis on generation of cheap hydel power. In pursuance of this policy, Wapda carried out studies to tap the maximum power potential of Tarbela. As a result it was found possible to install six units instead of four only on Tunnel - 2. Units 5 to 8 on Tunnel 2 were commissioned in 1982, and Units 9 and 10 in 1985. Four more power units of 432 MW capacity each installed on Tunnel - 3 commissioned in June, 1994. The total ultimate power potential of the project has thus been enhanced from 2,100 MW, as originally planned to 3,478 MW. Now including Tunnel No. 4 power generation enhanced to 4,888 MW. With the completion of Tunnel – 5 in 2025, total energy generation would become 6,408 MW. A 13 Member Delegation of Pakistan Engineering Congress headed by Engr. M. Anwar Qaseem Qureshi Member Executive Council / Joint Secretary – PEC and comprising of very Senior Engineers paid a Technical Visit to the Tunnel - 4 & 5 Project of the Dam They were briefed on the Salient Features of Tarbela Dam and

its energy productivity so essentially required for economic advancement of the Country / Food Security. The Team was taken around all Sections of the Project and given extensive briefing of Power House, NTDC Training Centre and above all Facilitation by all the Senior Executives. At the end Mementos of the Tarbela Dam and of Pakistan Engineering Congress were mutually exchanged. It was a very eventful Visit.

Pictures of Tarbela Dam T-4 & T-5 and NTDC Tarbela



Siting from Left Mr. Javed Iqbal PRO Tarbela Dam, Engr. Dr. Muhammad Riaz Member Executive Council PEC, Engr. Naveed Afzal, Engr. M. Anwar Qaseem Qureshi Member Executive Council PEC, Engr. Rana Muhammad Yamin Member Executive Council PEC, Engr. Nisar Mohy ud Din, Engr. Dr. Muhammad Saeed Member Executive Council PEC,

Standing for Left Mr. Muhammad Latif Office Assistant PEC, Engr. Zila Tahawar Abbas, Engr. Mubeen Shahid, Engr. Mubashir Bajwa, Engr. Mamoon Rizwan, Engr. Hafiz Muhammad Arslan,



View of Tarbela Dam



Briefing on Tarbela Dam



Briefing of Tarbela Dam by Engr. Zakir Atiq General Manager Tarbela Dam



Presenting a Memento Engr. Zakir Atiq G.M Tarbela Dam to Executive Council Members of PEC & Delegation



Group Photo with Engr. Zakir Atiq G.M Tarbela Dam



Group Photo of Delegation of Pakistan Engineering Congress



Group Photo with Principal of NTDC Training Center Engr. Fayaz Ahmad



Briefing of NTDC Training Center





Information about of Instruments of NTDC Training Center

Welcome Address
President Pakistan Engineering Congress
World Environment Day, 2023

“Beat the Plastic Pollution”

Distinguished Delegates,
Executive Council Members,
Fellow Engineers, Ladies & Gentlemen,

Assalam-o-Alaikum!

It is a matter of great honor and pleasure for me to welcome you all over here on the World Environment Day 2023. Today, we gather here on World Environment Day to address a pressing issue that threatens the very existence of our planet plastic pollution. Our theme for this year is "Beat the Plastic Pollution," and it is a call to action for each and every one of us to come together and tackle this global crisis that affects not only our environment but also our health, ecosystems, and future generations.

Ladies & Gentlemen!

Plastic pollution has become an enormous challenge that demands our immediate attention. Every year, millions of tons of plastic waste enter our oceans, rivers, forests, and landfills. This relentless flow of plastic threatens marine life, poisons our water sources, degrades our soil, and disrupts the delicate balance of our ecosystems.

We cannot deny the alarming impact of plastic pollution. It poses a grave threat to biodiversity, as marine animals mistakenly consume plastic, leading to their suffering and death. Additionally, plastic waste entangles and suffocates countless marine creatures, contributing to a catastrophic decline in oceanic biodiversity. The consequences are not limited to the oceans alone; plastic particles have even infiltrated the food chain, potentially posing health risks to humans.

Ladies & Gentlemen!

The time has come for us to take collective action. We must be proactive in our approach to address this crisis and bring about meaningful change. It starts with raising awareness about the devastating effects of plastic pollution and educating ourselves and others about sustainable alternatives.

Reducing plastic consumption should be at the forefront of our efforts. We must prioritize the use of reusable items instead of single-use plastics. Let us remember to carry our own bags, bottles, and utensils to avoid contributing to the massive amounts of plastic waste generated daily. Recycling and upcycling should also be actively promoted and practiced to ensure that plastic waste is diverted from landfills and given a new life.

Ladies & Gentlemen!

Furthermore, we must hold industries accountable for their plastic production and disposal practices. Encouraging businesses to adopt eco-friendly packaging alternatives and invest in research and development of sustainable materials is

crucial. Governments should enact stricter regulations and policies to curb excessive plastic production and promote a circular economy that minimizes waste and encourages recycling.

However, it is not enough for governments and industries to act alone. Each of us has a role to play in this battle against plastic pollution. We must make conscious choices in our daily lives to reduce, reuse, and recycle. By making small changes in our habits and lifestyles, we can collectively make a significant difference.

Education and community engagement are key to fostering a sustainable future. We must inspire the younger generation to become environmental stewards, nurturing their understanding of the importance of conservation and the impact of their choices. By involving schools, universities, and community organizations, we can empower individuals to become advocates for change and ambassadors of a plastic-free world.

Ladies & Gentlemen!

Plastic is predominantly produced from oil and gas, both of which are fossil fuels. The more plastic we make, the more fossil fuel is required, the more we intensify the climate crisis. Also, plastic products create greenhouse gas emissions across their whole lifecycle. If no action is taken, greenhouse gas emissions caused by plastic could account for 19% of the Paris Agreement's total allowable emissions in 2040 to limit warming to 1.5 degrees Celsius

Pakistan's pollution laws forbids the discharge of effluents, waste and air pollutants are met with oblivion. And resistance from retailers and consumers defeated the government's SRO to ban plastic bags in 2020. In April, the climate change ministry disclosed that the production level of plastic waste was 3m tons and, according to UNEP, only 3pc is recycled. If unaddressed, this will stand at 12m tons by 2040.

A World Bank survey in 2022 claimed 10,000 tons of macro plastics flow through the Indus into the sea annually. Meanwhile, untreated sewage and solid refuse continue to ravage Karachi's marine ecology. The fatal threat of toxic plastic, which makes flora, fauna and humans sick, must emerge as a rebel yell for environmentalists and media. Also, without a habit revolution, a plastic ban is just the tip of a rapidly dissolving iceberg.

Ladies & Gentlemen!

On this World Environment Day, let us recommit ourselves to the cause of beating plastic pollution. We must remember that the choices we make today will determine the quality of life for future generations. By joining hands, we can create a world where plastic pollution is no longer a threat, where nature thrives, and where our children can enjoy the beauty and abundance of a healthy planet.

Together, we can beat the plastic pollution.

With this preamble, I'd like to conclude my welcome address by thanking you all again for your very patient hearing.

Thank you.

WORLD ENVIRONMENT DAY 2023 ON THE THEME OF "BEAT PLASTIC POLLUTION" HELD ON SATURDAY JUN 17, 2023

1. The World is being in-undated by plastic. More than 400 Million tones plastic is produced every year, half of which is designed to be used only once. Of that, less than 10-percent is recycled. An estimated 19-23 Million Tones end up in lakes, rivers and seas. Today, plastic clogs our Land-fills, leaches into the ocean and is comb used into toxic smoke, making it one of the gravest threats to the planet.

2. Not only that, what is less known is that microplastics find their way into the food we eat, the water we drink and even the air we breathe. By some estimates, people consume more than 50,000 plastic particles per year and many more if inhalation is considered. May plastic products contain hazardous additives, which may pose a threat to our health.

3. Pakistan Engineering Congress assembled the distinguished specialists of Environment, Chemical / Polymer Engineers and Experts of Marine & Coastal Environment, Seven (7) papers were presented as under:

    i. Beat Plastic Pollution.

    ii. Circular Economy: A Transformative solution to curbing Plastic Pollution in Pakistan.

    iii. Challenge and prospects of Plastic circular Economy in Pakistan to manage Water in a sustainable way.

    iv. The Silent invaders: Microplastics and the impending Global hazard.

    v. Investigating the potential of artemia and daphnia magna for Microplastics removal for Water resources.

    vi. World Environment Day, 2023 – A conference tralk.

    vii. Identification and Assessment of Marine debris using satellite and aerial imagery in coastal Waters of Karachi, impacts on marine and coastal Environment.

4. Upon completion of Technical Sessions a lively Question / Answers Session ensued. Engr. Amjad Saeed, former President, PEC and Chairman of Technical Session gave concluding remarks. Afterwards, Congress Shields / Certificates were conferred on the Speakers. It was a widely attended event.

World Environment Day 2023 on the theme of "Beat the Plastic Pollution"



(From Left) Engr. Amjad Saeed, Engr. Najam Waheed President-PEC, Engr. Muhammad Ammar Publicity Secretary-PEC.



Engr. Muhammad Ammar Member Executive Council Conducting the Proceedings



Engr. Najam Waheed President-PEC Presenting Welcome Address at the event



Engr. Najam Waheed President-PEC Presenting Welcome Address at the event



Chairman of the Session Engr. Amjad Saeed delivering Concluding Remarks at the event



(From Left) Engr. Chairman of the Session Engr. Amjad Saeed and Engr. Najam Waheed President-PEC presenting Congress Shield to Ms. Rimsha Azhar for her paper on "Challenges and Prospects of Plastic Circular Economy in Pakistan to Manage Water in a Sustainable Way"



(From Left) Engr. Chairman of the Session Engr. Amjad Saeed and Engr. Najam Waheed President-PEC presenting Congress Shield to Dr. Yasir Qayyum for his paper on “Beat Plastic Pollution”



(From Left) Engr. Chairman of the Session Engr. Amjad Saeed and Engr. Najam Waheed President-PEC presenting Congress Shield to Ms. Javeria for her paper on “Circular Economy: A Transformative Solution to Curbing Plastic Pollution in Pakistan”



Engr. Najam Waheed President-PEC presenting Congress Shield to Chairman of the Session Engr. Amjad Saeed



Group Photo

Glimpses of Audiences





Glimpses of Audiences





SEMINAR FOR *"BRIDGE INSPECTION AND DIAGNOSIS"* HELD ON SATURDAY 03RD JUNE 2023 AT MASHHADI HALL PAKISTAN ENGINEERING CONGRESS HQ

The seminar was held in collaboration with Communication & Works Department (C&W), Government of the Punjab to discuss various methodologies to assess the condition of the bridges, mechanism to define bridge rating and inspection procedures adopted in Japan, which are considered to be an integral part of effective Road Asset Management.

C&W Department, Government of the Punjab is developing Pavement Management System (PMS) and Bridge Management System (BMS) with technical assistance of Japan International Cooperation Agency (JICA). BMS comprises of compiling inventory data of bridges, inspection mechanism & manuals, diagnosis of bridges periodically and then prioritization of bridge maintenance works to formulate "Annual Maintenance Plan". The demand of budget is to be generated based on said prioritized plan to ensure timely Maintenance & Repair (M&R) of damaged structures. Unlike pavements, severe damage or collapse of bridge structures can not only prove to be fatal but it can also cause traffic disruption. This may lead to road network dis-connectivity, bringing the entire socio-economic activity to a halt. Therefore, it is need of the hour for Punjab province to compile a database and have a close inspection of bridges to diagnose damage at an early stage in order to repair it which may otherwise lead to complete or partial collapse of structure. The conditions of the structures on road network are generally inspected visually by evaluating the distress severity and extent of damage. Based on these parameters, an overall rating is assigned to each structure and accordingly, budget demand for M&R of structures is to be prepared for approval. Inspection of the bridges itself is a very difficult and cumbersome job and cannot be standardized as type of structure, construction material differs from structure to structure. Therefore, each bridge needs to be considered separately for inspection and diagnosis.

There are many complexities associated with bridge inspection &diagnosis and to discuss some of them, experts from academia, bridge designers of C&W Department and Japanese expert (from Pacific Consultants Pvt. Ltd. hired by JICA) were invited to the seminar. The topics of papers presented in seminar are given below;

1. Condition Assessment of Bridge (History, Overview and Case Study)
2. To index the Bridge Performance by the Vehicle Induced Vibration
3. Common Defects Found in Various Bridges and their Rectification Techniques
4. Detailed Inspection of Bridges and Rehabilitation
5. Corrosion Damage in Steel Girder Bridge and its Evaluation
6. Introduction to Master Bridge Damage Catalogue

After the research papers were presented, an interactive Question & Answer session took place between the Speakers and the audience. The Chairman and Co-Chairman for the technical session were Engr. ZubairImranKhawaja and Engr. Ch. Muhammad Arif, AZ Engineering Consultants. The concluding remarks were delivered by Engr. ZubairImranKhawaja. Shields were conferred on the speakers by Pakistan Engineering Congress. It was a highly attended event.



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Dr. Azhar Saleem Presenting his paper on the Topic of “Condition Assessment of Bridge (History / Overview)”



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Dr. Tauqir Ahmad Presenting his paper on the Topic of “To Index the Bridge Performance by Using Vehicle Induced Vibrations”



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Engr. Hafiz Shoaib Presenting his paper on the Topic of "Common Defects Found in Various Bridges and their Rectification Techniques"



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Engr. Muhammad Afzal Presenting his paper on the Topic of "Inspection of Bridges and Rehabilitation"



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Dr. Nauman Khurram Presenting his paper on the Topic of "Corrosion Damage in Steel Girder Bridge and its Evaluation"



(From Right) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC, and Engr. Zubair Imran Khawaja Chairman of the Session presenting Congress Shield to Eiichi Tsugi MUTO Presenting his paper on the Topic of "Introduction to Master Bridge Damage Cataloque"



(From Right) Engr. Dr. Javed Iqbal Member Executive Council-PEC on the behalf of President-PEC presenting Congress Shield to Chairman of the Session Engr. Zubair Imran Khawaja



(From Right) Engr. Dr. Javed Iqbal Member Executive Council-PEC on the behalf of President-PEC presenting Congress Shield to Co-Chairman of the Session Engr. Ch. Muhammad Arif

Seminar on the Theme of "Bridge Inspection & Diagnosis"
held on June 3, 2023



Engr. Muhammad Ammar Member Executive Council Conducting the Proceedings



(From Left) Co-Chairman of the Session Engr. Ch. Muhammad Arif Vice President-PEC , Chairman of the Session Engr. Zubair Imran Khawaja, Engr. Muhammad Ammar Publicity Secretary-PEC.

Glimpses of Audiences





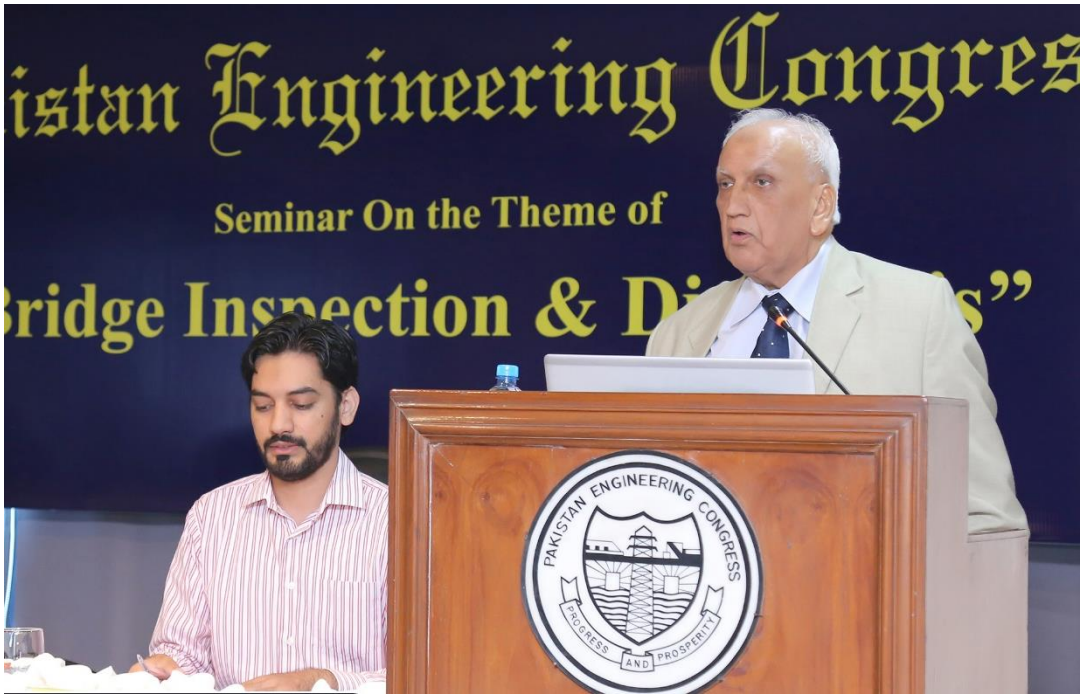
Glimpses of Audiences





Question / Answers Session





Chairman of the Session Engr. Zubair Imran Khawaja delivering Concluding Remarks at the event

REKO DIQ PRODUCTION TO BEGIN IN 2028

By:

Zafar Bhutta



Leading financial institutions have indicated that they will finance the Reko Diq project, which will require $7 billion.

Barrick Gold will complete project's feasibility study update by end of next year

Barrick Gold has projected that the extraction of metals in the Reko Diq Copper and Gold Project will begin in 2028 and its feasibility study will be finalised by the end of next year.

Talking to a select group of journalists, Barrick Gold Corporation President and Chief Executive Mark Bristow revealed that following the completion of legal processes and definitive transaction agreements with Pakistan and Balochistan governments last month, the company planned to finish the Reko Diq project's feasibility study update by the end of 2024.

Year "2028 is targeted for first production from the giant copper and gold mine in Balochistan province," he announced and described the project as "a significant new frontier of gold and copper in the world".

Barrick Gold will complete the project in two phases. In the initial phase, it will reset the feasibility study consisting of legal, financial and environmental documents.

The CEO recalled that they had completed the feasibility study with previous partners back in 2013.

"We have checked resources of this project, which are reliable, and the key thing to complete is to finalise the geotechnical work around the deposits," he said. "We need to continue the investment we have already started. This is one principle."

Power, water and infrastructure are the other key components that will assist the first optimal step of production. A social and environmental base line study will also be conducted.

"We have a lot of data regarding environmental study. We want to refresh and validate the data in line with best international standards," he emphasised.

Regarding the construction phase, the CEO pointed out that it would take around three years starting 2025 and they expected to make first production in 2028.

"Copper is promising a transition to clean energy around the world, therefore we need a lot of copper, which is the base of all electronics," he said. "Renewable resources and industry need more copper. If you want to develop cities, copper is a fundamental thing."

Regarding government's assurances, the company CEO pointed out that they had signed an agreement during Imran Khan's government, adding that Sharif's administration also delivered and signed a framework agreement, which "is a positive thing".

In the project, Balochistan has been recognised as a significant stakeholder. Barrick Gold has a similar situation in Tanzania, where it has re-engaged with authorities with 50-50 partnership.

Voicing hope that the Reko Diq project would benefit everyone, Bristow disclosed that they had invited Balochistan leadership to visit some of their operations in Africa.

He boasted that for the first time they had concluded agreements with all stakeholders. "We also took the agreements to the Supreme Court and made them public to ensure transparency."

Regarding project financing, the CEO said that leading financial institutions had indicated that they would finance the project, which would require $7 billion.

Out of the total, $4 billion will be needed in first phase whereas $3 billion will be injected in second phase. Fifty per cent of funding will be arranged through equity whereas the remaining 50% will be debt.

Pakistan's government has granted 15-year tax exemption to the project. However, Bristow added that they would pay royalty to Balochistan and invest in local community to execute different water and educational projects.

According to a statement, Reko Diq will be operated by Barrick Gold, which owns 50% of the project, with Balochistan holding 25% shareholding and three Pakistani

state-owned enterprises sharing the remaining 25%. The shareholding structure is in line with Barrick's policy of benefit-sharing partnerships with its host countries.

As part of a three-day project review that began in Quetta, Bristow, accompanied by senior Barrick executives, met with Balochistan Chief Minister Abdul Quddus Bizenjo and other provincial leaders.

He briefed them on the extensive social and economic development opportunities that would be generated by the mine, which was expected to have a life of at least 40 years.

After the meeting, Bristow and Balochistan chief minister signed a memorandum of agreement, which specified a timetable for the disbursement of committed funds to the province, including advance royalty and social development financing.

It will ensure that the people of Balochistan start reaping benefits of the project well before the mine goes into production. The agreement provides for an initial payment of $3 million this month.

Barrick is working to set up community development committees to identify priority projects focused on food security, environmental management and access to education, healthcare and potable water.

Courtesy The Express Tribune, January 17th, 2023

GLOBAL WARMING: NEW WORRYING EVIDENCE

By:

Shahid Javed Burki

Abnormal weather events in places tens of thousands of miles apart are likely to become the norm

Last summer, Pakistan suffered from the effects of global warming. What were described as “biblical floods” hit the country’s south and killed thousands of people and tens of thousands of animals. The floods followed unprecedented rains and also unexpectedly large amounts of water that flowed down the Indus River. The Indus received more water than it could handle because of the melting of the ice in the Himalayas and the Hindu Kush Mountains. A warmer than normal air carried more water and deposited it as rain in lower Sindh including the normally dry megacity of Karachi. The country should expect more of the same this summer and the summers that follow. It has to prepare itself to handle these crises — a subject I will get back to later in this article.

The year 2023 has started with unprecedented rain and floods in the state of California on the United States’ west coast. For several years in the past, dry and hot air had brought fires to the state’s forests destroying hundreds of thousands of acres that had been covered by dense forests for centuries. “California once wished for rain. Now floods devastate its towns,” headlined The Washington Post in a story it carried on the front page of its issue of January 11. Drought that lasted for half a decade was the worst in 1,200 years and caused farm fields to wither. “Now, the water that California so desperately wanted is pummeling them like a curse. It’s surging over riverbanks and rushing through, toppling drought stressed trees, turning scorched mountain-sides into avalanches of mud.” The newspapers in the West had used the same kind of language to describe floods and rains in Pakistan in the summer of 2022.

These abnormal weather events occurring in places that are tens of thousands of miles apart will no longer be rare but are likely to become the norm. This was predicted by several sweeping record-based studies released in the last few days by international agencies. An analysis released by the European Earth monitoring agency Copernicus showed that the last seven years in the Continent were history’s hottest with 2021 coming in as the fifth hottest. The same conclusions were reached by NASA which found that the past 12 months were the hottest on record, with the planet warming by 1.1 degrees centigrade above the pre-industrial level. Bill Nelson, the Agency’s head, said that “science leaves no room for doubt: climate change is the existential threat of our time. Eight of the top 10 warmest years on the planet occurred in the last decade, an indisputable fact that underscores the need for bold cation to safeguard the future of our country — and of humanity.”

Normally, climate analysts focus their attention on Africa and South Asia — the two regions most likely to bear the brunt of the adverse consequences of global warming. But now they have begun to worry about Europe and North America as

well. In 2021, Europe suffered its hottest summer on record, when temperature hit 48.8 degrees centigrade in Sicily — this temperature was almost the same as that in Jacobabad, the hottest city in Pakistan — which produced devastating wild fires that ripped through Italy, Greece and Turkey. This was coupled with catastrophic floods which swept through Germany and Belgium. Even Canada was not spared. Temperature of 49.6 degrees Celsius was recorded in Lytton. The country's official meteorological agency recorded 2021 as its hottest year in history, when average temperatures hit 10.7 degrees centigrade, a full one degree above the normal.

What should be of particular worry for Pakistan is the faster melting of glaciers that feed its rivers in the summer months and conserve water as ice in winters. According to a study published on January 7, 2023 in the journal Science, nearly half of all glaciers will melt by the end of this century. The planet has been gradually losing glacier ice since the peak of the last major ice age, some 20,000 years ago. Three degrees centigrade of warming, the researchers found, would translate into loss of over 70% of global glaciers and result in about 5 inches of global-sea-level rise.

The study identified four areas where glaciers affect the weather systems. In addition to the two poles, the Arctic and the Antarctic, there are large expanses of ice in Greenland and the Himalayas and the Hindu Kush mountains. The last is sometimes referred to as the third pole considering the amount of ice it holds and the age of the ice. Most glaciers cover a small area. Roughly 80% of the world's glaciers are less than one square kilometer. According to David Rounce who led the study published by the journal Science, most glaciers are very small. "When you think about future changes in a warming climate, they are very challenged in order to survive," he wrote. Some 104,000 of the world's more than 215,000 mountain glaciers and ice caps will melt by the end of this century, producing floods in the rivers they feed and raising sea levels equivalent to a little less than 4 inches.

This brings me to public policy aimed at controlling the adverse effects of global warming. There are lessons policymakers in Islamabad could learn from the measures adopted by Bangladesh. The country is prone to climate disasters which include cyclones, sea-rise and floods. The steps the country has taken fall into three categories: infrastructure adjustments; early warning systems; and efficient channels for financial relief. All these measures have saved many lives. In 1970, when Bangladesh was a part of Pakistan, 300,000 to 500,000 people died in a massive cyclone that hit the coastal areas. A similar one in 2020 killed only about 30.

Pakistan has also created institutions to predict and manage natural disasters. It improved its early-warning systems after flash floods killed more than 2,000 people in 2010 which may have helped reduce the death toll from the floods that hit the country in the summer of 2022. However, while it has developed institutions that transfer government finance to the people in need, it has to link them to those who are not necessarily poor but can be seriously hurt by natural disasters. Pakistan has to start planning to deal with the melting of ice in the large glaciers that sit on top of the mountain ranges in the east and northeast of the country. While the country has considerable experience in managing floods, it does little to store the water that flows down the many rivers that originate in the Himalayas and Hindu Kush ranges. As I have written in an earlier article, the suggestion made by the World Bank some

years ago to build a cascade of storages in the Indus after the river has left the mountains and entered the planes will save water that will be needed when the flow declines because of ice-melt. These will cost a great deal of money but can be financed by the large amounts that are planned to be given to the World Bank and the Asian Development Bank to deal with the disasters that are going to hit the developing world because of global warming.

Courtesy The Express Tribune, January 16th, 2023

REFORMS REQUIRED FOR GROWTH

By:

Our Correspondent

World Bank suggests harmonising direct taxes, lowering import duties

Pakistan's economy is standing at a critical juncture – one where contingencies have long stopped working and long-term structural imbalances need to be addressed.

According to a new World Bank report released on Friday, the global lender put forth many crucial policy recommendations including harmonising direct taxes across sectors.

"Key to Pakistan's sustainable recovery is productivity and investment growth. But distortions have made it elusive," said Gonzalo J Varela, Senior Economist and Co-Author of the report in a press statement.

"First, reduce distortions that misallocate resources and talent. Second, support growth of firms through smart interventions, rather than through blanket subsidies. Third, create a positive, dynamic loop between evidence and policymaking and strengthening feasibility analysis of publicly funded projects or programs," suggests the report.

According to the report, Pakistan's economy can grow sustainably only if the country introduces productivity enhancing reforms that facilitate a better allocation of resources into more dynamic activities and of talent to more productive uses.

The report titled 'From Swimming in Sand to High and Sustainable Growth', finds that the country's inability to allocate all its talent and resources to the most productive uses has stunted economic growth. It then proceeds to present evidence of systematic productivity stagnation across the firms and farms.

"In manufacturing and services, most of the productivity stagnation is related to firms losing efficiency over time. The report also shows a systematic decline in agricultural productivity, as well as a strong link between elevated temperatures and rainfall variations and productivity."

The report presents a roadmap to reduce distortions in the country's economy that are currently acting as a deterrent to productivity growth.

Critical reforms recommended include harmonising direct taxes across sectors so that more resources flow into dynamic tradable sectors like manufacturing and tradable services, instead of real-estate and non-tradables; reducing the anti-export bias of trade policy by lowering import duties and reversing the anti-diversification bias of export incentives.

Productivity is further affected by the fact that Pakistan does not tap into all of its talent. "Women in Pakistan have made progress in educational attainment, but this accumulated human capital is underused because of constraints they face to

participate in the labour force," stated Najy Benhassine, World Bank Country Director for Pakistan in a press statement.

"With only 22% of women employed in Pakistan, women's labour force participation is among the lowest in the world. By closing the female employment gap relative to its peers, Pakistan can accrue GDP gains of up to 23%. Successful implementation of policies to address the demand- and supply-side barriers to female labour force participation, can create about 7.3 million new jobs for women."

The also report urges Pakistan to maximise positive impact on businesses and productivity across the board by reducing regulatory complexity; harmonising the general sales tax (GST) across provinces; reforming investment laws to attract more foreign direct investment; and upgrading insolvency laws to reduce the costs of liquidating non-viable firms.

In the meantime, providing safe and affordable mobility especially for women; boosting digital connectivity and digitally enabled jobs; demonstrating the benefits of increased female labour force participation to positively shift entrenched norms; developing skills; and reducing sectoral gender bias are among the top and medium-term recommendations of the report.

"Firms in Pakistan struggle to grow large as they grow old. A young formal firm in Pakistan that has been in operation for 10 to 15 years is about the same size as a firm that has been in operation for more than 40 years. Similarly, an average Pakistani exporter is less than half the size of one in Bangladesh. This shows a lack of dynamism amongst Pakistani firms, compared to better functioning markets, where firms either grow or exit," said Zehra Aslam, Economist and co-author of the report.

Courtesy The Express Tribune, February 11th, 2023

PAK SCIENTISTS MAKE NANO-DISCOVERY

By:

SUHAILYUSUF

Design a highly selective sensor to detect iron in water, Parkinson's patients

A team of Pakistani scientists developed fluorescent nanoparticles from spent tea through an eco-friendly procedure. These nanoparticles could act like sensors in various medical applications.

Aumber Abbas — a PhD scholar at the Newcastle University, UK and others from Oxford University UK, made this discovery by converting tea waste into Graphene Quantum Dots (CODs) to design a highly selective sensor to detect iron in drinking water and Parkinson's patients.

The tiny particles are made from graphene - an allotrope of Carbon discovered in 2004 - consist of a sheet of carbon atoms that could be collected from a piece of graphite with scotch tape. The discovery of this magic material was awarded the Nobel Prize. Till then, graphene is an ideal material for new explorations in material science, medicine and other fields.

Scientists and engineers around the world are still busy in fine-tuning graphene for desirable results. For instance, in March 2018, Pablo Jarillo-Herrero at the Massachusetts Institute of Technology (MIT) found that when a one-atom-thick sheet of graphene placed on another with slight twist, the material shows super conductivity. Similarly, the quest for fluorescence in CODs led the team to do some more tweaks.

The blue light

The entire standard test shows that a single dot is in 1 to 5 nanometers in size with a thickness of one nanometer. They are so tiny that a one billion such dots will fit back-to-back in one-meter single line drawn on a sheet and this is why they called, nano - one billionth of a meter - particles.

Now, the CODs are able to detect the presence of iron or its states based on their strong luminescence of blue color and turned into a sensor. The presence of iron instantly switches off the fluorescence of CODs. The Graphene Quantum Dots were tested for 17 different metals ions dissolved in solution and they showed highest switching off response in the presence of Iron. Thus they have a promising future of iron detection in biological or environmental system.

We know that abnormal iron buildup in brain increases the cognitive decline and could lead to Alzheimer disease. Iron accumulation is also harmful in water and environmental systems. The newly devised CODs could be vital to detect Iron in many applications.

On the other hand, the particles are made with green, acid free and cost-effective approach with raw material which is abundant

ADB MAKES SECOND OFFER TO FUND CPEC'S $10B ML-I PROJECT

By:

Shahbaz Rana



Bank has only offered to finance the portion severely damaged by floods

The Asian Development Bank (ADB) has offered to fund China-Pakistan Economic Corridor (CPEC)'s $10 billion Mainline-I (ML-I) project, said the administration head of the planning ministry on Wednesday – a move that may require Beijing's consent in order to onboard a second financier.

"ADB has offered to finance the ML-I project," said Zafar Ali Shah, Secretary of the Ministry of Planning while talking to the journalists at his office.

To a question, Shah said "Pakistan is still pursuing the project with Beijing and is keen to start the first phase of $2.7 billion." Sources, however, said that China has not yet signed a financing agreement due to differences over terms and Pakistan's weak financial position.

This is the second time that the ADB has shown interest in the delayed project – also the only scheme to be declared strategically important under the CPEC framework.

Nearly eight years ago, ADB had offered to finance the said scheme but China declined their proposal.

A diplomatic source privy to these discussions said that ADB has only offered to finance the portion of the ML-I project severely damaged by the recent floods. He said that, at this stage, the financing and scope of the ADB offer has not been finalised. Of the total cost of $10 billion, Pakistan has planned to take a loan of $8.4 billion from China, although it has not been able to finalise negotiations, and Islamabad will arrange the remaining $1.5 billion.

In rupee terms, the project cost, which was a staggering Rs2 trillion at the time of its approval four months ago, has now increased to Rs2.7 trillion at today's exchange rate.

Pakistan had decided to implement the project in phases and stagger the loan of $8.4 billion accordingly to ensure smooth construction and at the same time book loans as per its need. Due to the Pakistan Tehreek-e-Insaaf (PTI) government's negligence, however, the ML-I project remained side-lined and as a result its cost in rupee terms increased three folds. In the past 10 months, however, the Pakistan Democratic Movement (PDM) government too has failed to break the deadlock with China.

During Prime Minister Shehbaz Sharif's visit to China in November, Pakistan proposed the signing of a joint memorandum, indicating the timelines of project milestones but nothing was finalised. Under the project, a 1,733km-long route will be rehabilitated, 482 underpasses, 53 flyovers, 130 biker bridges and 130 stations will be constructed along the route. The ML-I starts from Karachi, passes through Kotri/Hyderabad, Rohri, Multan, Lahore, and Rawalpindi.

In August 2020, the Executive Committee of the National Economic Council (ECNEC) had approved the ML-I project at a cost of $6.8 billion, including a $6 billion Chinese loan. The project, however, could not reach ground-breaking stage due to a disagreement over loan terms and China's objections to the cost of the scheme.

The PDM government has now approved the cost of $10 billion, a surge of over $3 billion, or 45%. The increase has been approved for all three packages of the project that are planned to be constructed from 2023 to 2031.

Pakistan faces the gigantic task of avoiding default and, at the same time, meeting its financing needs.

In a background briefing, the Ministry of Finance said last week that the government will have to slash the Public Sector Development Programme (PSDP)'s budget for the sake of the International Monetary Fund (IMF). The secretary planning, however, said that as of Wednesday there had been no cut on the Rs727 billion budget approved by the National Assembly. He added that no such decision had been communicated to the ministry.

During the first seven months of the fiscal year, Rs207 billion of the budget were spent, which were equal to 28% of the annual allocations. The secretary said that foreign project funding was picked during the first seven months as the entire annual budgeted Rs60 billion were received during this period.

He hoped that after the approval of the $3 billion flood related projects, about $1 billion should flow in the current fiscal year. The assumption, however, appears to be on the higher side.

To a question, the secretary said that the cost of the $1.5 billion Sindh Housing flood rehabilitation project has been reduced to $727 million. The provincial government had hoped that it would receive $1.5 billion in foreign assistance but only $500 million was given by the World Bank, he added.

Courtesy The Express Tribune, February 9th, 2023

BITTER-SWEET PILL: IMF'S RAMIFICATIONS

By:

Salman Siddiqui

Average inflation reading is projected to be 25% for FY23, but will continue to rise

Pakistan is expected to narrowly escape defaulting on its international payments after the International Monetary Fund (IMF) finally agreed to continue discussions under the ninth EFF (Extended Fund Facility) review, now that the government gave up control of the rupee-dollar exchange rate.

Speaking to The Express Tribune, Ismail Iqbal Securities Head of Research Fahad Rauf said, "As a positive impact of the revival of the lending programme, Pakistan has successfully mitigated its risk of default. Hopefully, the country's foreign exchange reserves will start improving now." Now that the IMF has agreed, however, some of the strict conditions imposed are likely to result in negative economic growth and hyperinflation in the country.

"Pakistan's GDP growth is estimated to grow by negative 1% in the current fiscal year 2023 and the nation will face high inflation over the next six to twelve months," he stated. In the wake of implementing the IMF's conditions, the average inflation reading is projected to be 25% for FY23, but will continue to increase by another 10-15% in the next fiscal year 2024.

Arif Habib Limited Head of Research Tahir Abbas said, "The inflation reading will be worse in case Pakistan defaults and the IMF programme remains stalled. No economic measure is going to be painless at this moment. Implanting the IMF programme is like taking a bitter pill – it is a remedy to the current financial turmoil only..." Explaining the situation, Alpha Beta Core (ABC) CEO Khurram Schehzad said, "Just from an impact perspective, the depreciation of every Rs.10 against the US dollar will add an additional Rs.1.3 trillion to our foreign debt."

"So, when the currency went down by 25/$ (from 230/$ to 255/$) on Thursday, an additional Rs. 3,250 billion (Rs.3.25 trillion) was added to the country's foreign debt," he explained.

The impact of IMF's conditions

With no other options left, Prime Minister Shehbaz Sharif categorically said his government is ready to take all the necessary decisions required to revive the IMF programme worth $6.5 billion.

Of the four major prerequisite conditions, needed to be met to revive the lending programme, the government has fulfilled the first one by letting the market forces determine the rupee-dollar exchange rate. Accordingly, the local currency plunged by Rs. 24.54 (or 9.61%) to an all-time low at Rs. 255.43 against the US dollar in the interbank market on Thursday.

"The steep decline in the exchange-rate may increase petroleum products (POL) prices by up to 50% in the weeks and months to come – if it remains at its current level. The petroleum development levy is set at Rs.50/litre on petrol and diesel each,

and a sales tax is imposed at 17% on POL products as well, going forward," estimated Rauf.

The price of petrol is projected to increase by 44% to Rs.309/litre from Rs.215/litre at present, while the price of diesel may spike by 50% to Rs.341/litre from Rs.228/litre.

In addition to this, all imported goods will become more expensive by an additional 10%, due to the nearly 10% drop in value of the rupee against the greenback on Thursday. These goods will include food (wheat and wheat-flour, pulse and cooking oil), cotton for textile, steel scrape, energy products (oil, gas and coal).

The rising price of essential commodities, however, will hit the common man the most, particularly those from the lower-income segments of society who were already struggling due to the ongoing financial turmoil and political upheaval. AHL Head of Research Abbas said the other three of IMF's prerequisite conditions include the imposition of new taxes worth Rs.280-300 billion, increasing the price of electricity by Rs.7/unit and raising the price of gas by 70-75%.

All of three conditions are expected to be implemented within the next one-week to 10-days.

A presidential ordinance is expected to implement new taxes, while the power and gas tariff will be increased by the Economic Coordination Committee (ECC) of the cabinet and the federal cabinet. "The impact of all the prerequisites will be both positive and negative," said Abbas.

The positive impact of the rupee depreciation will be that the workers' remittances being sent home by overseas Pakistanis will start improving. For the past three months, remittances were getting diverted to the black-market as the exchange rate was being artificially managed by the government. Now, however, the inflows will steer back towards the official channels. Secondly, the exporters, who were waiting for the much-awaited and expected devaluation of the rupee, will now bring their proceeds into the country. As a result, export earnings will also increase in the months to come.

Moreover, imports are likely to drop. Accordingly, the current account deficit will narrow down further, the country's foreign exchange reserves will surge and the country's capacity to make international payments will enhance.

The negative impacts of the IMF programme, however, will be high inflation in the range of 29-31% in February onwards.

The AHL analyst further said the new taxes being imposed will directly impact non-filers. The government is also considering imposing a tax on the withdrawal of cash from banks by non-filers.

Other steps under consideration are imposing taxes on banks' income from their foreign exchange business, federal excise duty on sugary drinks and cigarettes among other goods. Moreover, the increase in power and gas tariffs will hit both the business community and common man.

Ultimately, the hike in the tariffs will increase the cost of doing business and make exports uncompetitive at the regional and global levels.

Courtesy The Express Tribune, January 27th, 2023

PRIVATISATION REPORT FAILS TO MENTION $800M IN DUES FROM ETISALAT

By:

Shahbaz Rana

UAE company has not transferred $799.3m, holds 407.8 million shares

The Board of Privatisation Commission (PC), on Wednesday, endorsed a report that showed that receivables from privatisation stand at merely Rs.5.2 billion – the special report, however, did not mention the Rs163 billion in receivables from the Etisalat.

The board endorsed the report, which was prepared by Crowe Hussain Chaudhury & Co Chartered Accountants firm as external auditors for the audit of the Privatisation Commission's receivables as on June 30, 2022.

The outstanding dues speak poorly of the performance of the commission that already faces existential questions after the government enacted the new Inter-governmental Commercial Transactions Act 2022 deemed to carry out the sale of government assets on fast-track.

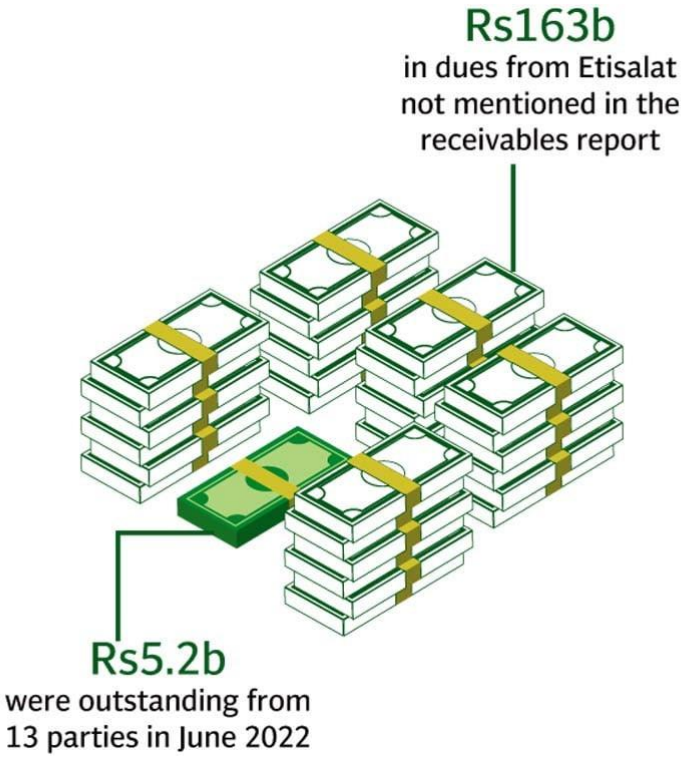
As per the report, about Rs.5.2 billion were outstanding from 13 parties as on June 30, 2022, the PC Board was informed on Wednesday. Of the Rs.5.2 billion, the maximum amount of Rs4 billion was outstanding against the Schon Group on account of privatising two entities decades ago. These include a principal amount of Rs.494.4 million.

The report, however, does not mention the outstanding dues of $799.3 million on PTCL's privatisation, which was surprising. PTCL's outstanding dues against Etisalat had been mentioned in a previous receivable report, prepared during the tenure of the Pakistan Tehreek-i-Insaaf (PTI). When contacted, Iram Khan, Secretary Privatisation did not respond to a request for comments.

An official of the commission said that PTCL's receivables will be mentioned in the audited financial accounts of the Privatisation Commission. This, however, does not absolve the commission for excluding the single largest liability from the receivable amount.

In July 2005, Pakistan had sold 26% of its holding in PTCL to Etisalat at a price of $1.96 per share. About 1.326 billion shares were sold at a total price of $2.6 billion. Since the past 12 years to date, however, Etisalat has not transferred $799.3 million and is holding 407.8 million shares without making due payments.

Since its privatisation in July 2005, PTCL has been declaring dividends and also claiming technical service agreement fees.



Etisalat is holding the $799.3 million due to the non-transfer of 31 properties. In 2019, Etisalat International valued the non-listing properties at Rs.31 billion, but instead of taking the forex rate of Rs140 prevailing in 2019, it converted the amount of Rs.31 billion at Rs.62.75 per dollar rate of 2008, which came to $499 million.

The PTI era's Receivable Committee had recommended placing the names of defaulters in the list of the Credit Information Bureau (CIB) and sending their cases to an anti-corruption watchdog. But nothing moved afterwards.

The privatisation programme started in 1991 and 142 entities have either been sold or had their shares divested in return of Rs.649 billion. About 25% of the proceeds, however, remain outstanding. At the end of June 2022's exchange rate, Etisalat owes Pakistan a whopping Rs.163 billion.

The PC has extended favours to certain buyers by first adjusting their payments against the principal, which was contrary to general accounting and banking practice, and in other cases adjusted receipts against overdue mark-up. The Sale Purchase Agreements (SPAs), however, did not provide for any adjustment procedure.

The PC Board was informed that the government sold the National Fibres Limited to M/s Schon Group for Rs.756.6 million. As on June 30, 2022, the receivable balance outstanding was Rs.932 million, including the principal amount of Rs.306.4 million.

The government had also sold Pak China fertiliser to M/S Schon Group for Rs.457 million. As of June, last year, over Rs.3 billion, including the principal amount of Rs.188.2 million and interest computed at the rate of 14% on the outstanding principal amount, along with a further mark-up of Rs.107 million on the outstanding mark-up amount was remaining. By June last year, an amount of Rs.182 million was outstanding against Pak PvC Limited including a principal amount of Rs.38.1 million.

Similarly, the outstanding balance from Sindh Alkalis Limited was Rs.141 million. The receivables from National Motors Limited stood at Rs.82.3 million, Rs.356 million from Balochistan Wheels Limited and Rs.204 million from Dandot works of National Cement Limited.

The Haripur Vegetable oil industry owed Rs.48.7 million and Crescent Factories Vegetable Ghee owed Rs.106.5 million. The Siranwali Rice Mills is yet to pay Rs.3.5 million and Quaidabad Wollen Mills Limited's pending payment is Rs.62.7 million.

Courtesy The Express Tribune, January 26th, 2023

WATER DISPUTE HEARING HELD AT THE HAGUE

By:

Hasnaat Malik

AGP Office rejects Indian claim, says treaty cannot be unilaterally modified

The first hearing of a dispute between Pakistan and India pursuant to the Indus Waters Treaty (IWT) began at the Permanent Court of Arbitration in The Hague, The Netherlands, a statement issued by Attorney General for Pakistan (AGP) Office said on Friday.

The AGP Office also took notice of the news stories appearing in the Indian press regarding New Delhi's attempted unilateral modification of the IWT, saying that such stories were misleading.

"The treaty cannot be unilaterally modified. This is an attempt to divert attention from the ongoing proceedings at the Permanent Court of Arbitration under the Indus Waters Treaty."

Reuters reported that an Indian government source said New Delhi had served Pakistan a notice to modify the treaty and wanted to meet to start resolving the long-running dispute within 90 days. Asked what modification New Delhi wanted, a second source said: "Whatever small differences that may come up, how they can be resolved without the involvement of any third party, since it is a bilateral treaty. A third party should not be required."

The AGP Office statement elaborated that the dispute pertains to concerns raised by Pakistan over India’s construction of the 330MW Kishanganga hydroelectric project on Jhelum River and plans to construct the 850MW Ratle Hydroelectric Project on River Chenab in Indian Illegally Occupied Jammu and Kashmir (IIOJK).

"Pakistan’s delegation is led by Pakistan’s Agent to the Court, Ahmad Irfan Aslam, Additional Attorney General and includes Hassan Nasir Jamy, Secretary, Ministry of Water Resources, and Syed Muhammad Mehar Ali Shah, Pakistan’s Commissioner for Indus Waters. Pakistan is represented by, among others, Sir Daniel Bethlehem, KC, a barrister from the UK."

Pakistan initiated legal proceedings on August 19, 2016, by requesting the establishment of the ad hoc Court of Arbitration pursuant to Article IX of the IWT.

Islamabad took this step after strenuously raising its concerns in the Permanent Indus Commission starting in 2006 for the Kishanganga project and in 2012 for the Ratle project, and then seeking resolution at government level talks held in New Delhi in July 2015.

Pakistan’s decision to initiate proceedings was in response to India’s persistent refusal to address Islamabad’s concerns.

"The treaty provides for two forums for settlement of the disputes – the Court of Arbitration that addresses legal, technical, and systemic issues and the Neutral Expert that addresses only technical issues. Pakistan requested the establishment of the Court of Arbitration because of systemic questions requiring legal interpretation."

India responded to Pakistan's initiation of a formal dispute settlement process by its own belated request for the appointment of a neutral expert.

Submission of a belated request for the resolution of disputes raised by Pakistan was a demonstration of India's characteristic bad faith, the statement added.

Courtesy The Express Tribune, January 28th, 2023

$1TR ECONOMY TARGETED IN 2035

By:

Shahbaz Rana

Govt aims to slash poverty to 15% under Pakistan Economic Outlook 2035

The National Economic Council (NEC) on Tuesday approved the Pakistan Economic Outlook 2035 concept for increasing the size of national economy to $1 trillion and reducing poverty to 15% - the ambitious goals that could not be achieved without political stability.

The Planning Commission's documents painted a bleak picture of Pakistan in 2035, if the new goals were not achieved and the political leadership failed to ensure stability in the country.

Headed by Prime Minister Shehbaz Sharif, the NEC, a constitutional body that approves macroeconomic plans, endorsed the concept of Pakistan Economic Outlook 2035.

It also approved the Annual Plan 2023-24, setting gross domestic product (GDP) growth target at 3.5% for the next fiscal year and inflation target at 21%.

"In the case of business as usual, the economic growth will be 3.5% even after 12 years," Ahsan Iqbal, Federal Minister for Planning, said after the NEC meeting.

The minister said that in the no-reforms scenario, the size of Pakistan's economy would be $573 billion in 2035 and "this can be almost doubled to $1 trillion, if we introduce reforms today".

In the current fiscal year, the economy grew a meagre 0.29%, which too was controversial, and the size of the economy was just $341.6 billion.

Political instability, rapid expansion of population, under-harnessed youth bulge, deficient human resources base and lack of continuity of policies remain the main challenges.

The nation needs to be made aware of the implications of "business as usual" and "aspirational" paths and choices to be made in order to achieve an aspirational path, the minister said.

In case Pakistan fails to bring reforms, in 2035 its population will be 340 million and it will be the fastest growing nation in the world, going to add a population of the size of South Korea in the next 10 years, according to the NEC documents.

Without reforms, by the year 2035, the economy is projected to grow by 3.5% on average with the agriculture, industry and services sectors following the traditional growth patterns.

With a low GDP growth and increasing population, the unemployment rate is expected to rise in the range of 9% by 2035.

Under the envisioned transformational scenario, the economic growth is expected to accelerate with an annual average of around 6% up to 2035 and growth acceleration in all sectors.

For the initial years, the government has not shown any major increase in the size of the economy, which is projected to start ballooning from 2027.

With the current pace, Pakistan's exports are shown at a mere $51 billion in 2035, which the Planning Commission said could be increased to $127 billion by reforming various sectors and making available adequate resources.

In the no-reforms scenario, imports are shown at $109 billion, which in transformational cases can increase to $200 billion due to import of hi-tech goods for industrialisation.

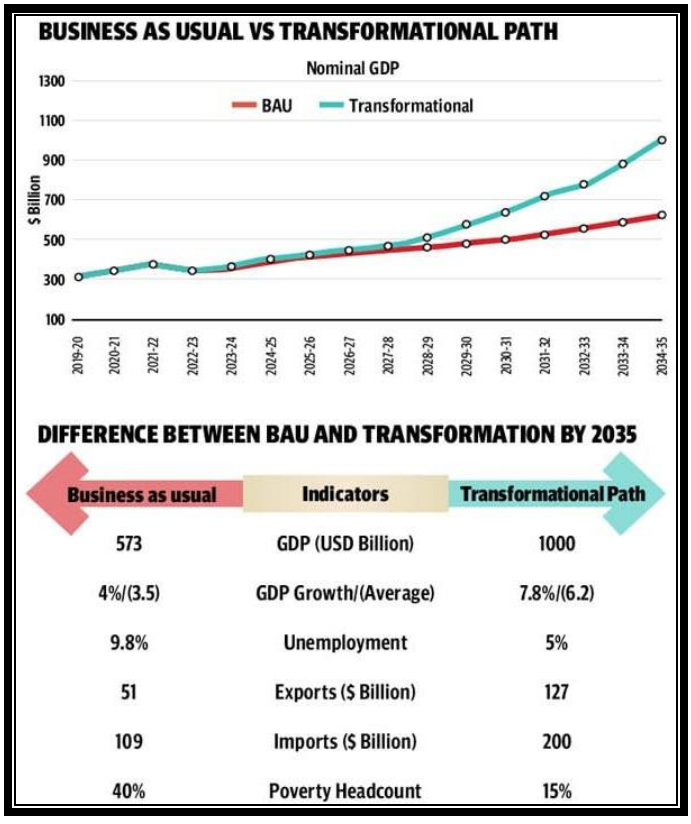
"If we could not increase exports to $100 billion in the next eight years, Pakistan will never be in a takeoff position and remain stuck in the debt trap," said Ahsan Iqbal.

Without a significant increase in exports, the external sector may remain volatile, leading to negative consequences for debt, deficit and currency value.

According to the concept paper, without structural transformation, Pakistan will have 40% of its population below the poverty line. An additional 8 million children will exert demand for additional 250,000 primary schools at the current rate of enrolment.

The unemployment rate can be reduced to around 5% and poverty rate to 15% by changing the path of the economy.

The current population growth also warrants augmenting the capacity of the civil apparatus to ensure better governance.



Overall, 35.3% of cases in the superior and district judiciary were pending. The average case per judge is 1,473. To keep the existing ratio of pendency, at least 1,065 more judges will be required in 2035.

In 2018, one police station was available for 61,574 people. In 2035, 1,218 new police stations will be required at the existing ratio.

“Pakistan has a choice to either keep business-as-usual approach or adopt a transformative path,” said the planning minister.

The business-as-usual approach to economic management and governance was unlikely to result in realisation of the true potential of the nation, he added.

The government claimed that the country was well on its way to achieve the goal of being among the top 25 economies of the world by 2025. Unfortunately, after 2018 the new government abandoned the Vision 2025 and put the country on a day-to-day management without any roadmap, it added.

To achieve sustained high GDP growth over a significant period, lasting at least two decades, Pakistan must allocate more resources for developing human capital and adopting productivity-enhancing measures. To this end, the investment-to-GDP ratio needs to increase from 13.6% in 2023 to approximately 22% in 2035, according to the concept paper.

Courtesy The Express Tribune, June 7th, 2023

BEWARE, HEATWAVES AHEAD!

By:

Muhammad Wajahat Sultan

Heatwaves impact all sectors of the economy, from agriculture to industry

In 2022, Pakistan witnessed harsh weather conditions from April to September due to heatwaves and irregular weather patterns. Heatwaves occur when a place's temperature exceeds its limits. During high pressure, winds are trapped toward the ground and heat is reflected by the ground. In this process, heat cannot escape the area. The McKinsey Global Institute predicted that more than 50 million people could suffer from the coming heatwaves in Pakistan. Heatwaves impact all sectors of the economy, from agriculture to industry. They reduce the population's productivity, increase the burden on the underprivileged, and jack up inflation.

According to World Bank reports, heatwaves decrease the productivity level of the employed population by 5-10%. This is a looming threat to the Pakistani population. Pakistan has a 74% employed population, of which 40–42% are directly involved in agriculture and exposed to outdoor working patterns. It is estimated that more than 40% of the working labour in Pakistan is employed under unorganised conditions, in addition to agriculture. Lethal heatwaves can adversely impact the working and underprivileged classes. The decrease in productivity levels of the working population can burden the economy more due to an underperforming index.

For instance, during heatwaves, wheat production decreases due to crop loss and crop damage. A labour-intensive job like wheat cutting becomes challenging in April and May. Heatwaves shrink labourers' productivity, which leads to productivity losses in the wheat output. And this loss of productivity leads to inflation. Wheat is the main ingredient in the diet of the majority of Pakistanis. Low productivity and crop losses due to heatwaves cause an extra burden on the economy, contributing to high inflation.

The other deadly factor that is absent from our policy orientation is the increase in supply and demand for electricity due to heatwaves. The rise of heatwaves causes an increase in demand for electricity. This abrupt demand for electricity causes an energy crisis in the country. Moreover, production of electricity in Pakistan is largely based on coal consumption. To produce more electricity, we consume more coal, which multiplies greenhouse gas emissions, leading to global warming.

For people who cannot afford cooling machines or ACs, the coming heatwaves are a nightmare. The World Bank Group's Country Climate and Development Report (CCDR) warns that the combined risks of extreme weather conditions in Pakistan can reduce GDP by 18-20% by 2050. This is a serious issue. Heatwaves should be considered the coming apocalypse for Pakistan in the coming years.

The Pakistan Cooling Action Plan has shaped some agendas in theory. In practice, it needs to be installed more maturely. Pakistan could, for example, work on a

sustainable cold chain system in which the cooling industry would be able to serve two purposes. On the one hand, it can work to provide cooling through cold storage and transport; and on the other, it can create half a million new jobs in this upcoming cold chain system. Extending the discussion, it is necessary to reduce cooling demand across the sectors and reduce refrigerator demand in the coming years.

The government needs to invest in regenerative agriculture, ecosystem restoration and social protection systems for those who are at high risk of heatwaves. At the individual level, we should create rooftop gardens in urban areas. As urban areas are becoming urban heat islands, there is an urgent need to create such gardens. This is because greenery and gardening can help reduce the heat in megacities, which are exposed to harsh weather conditions.

Finally, adaptation and proactive policymaking can reduce the coming threats of inflation due to heatwaves, productivity paranoia and agricultural outcomes. Footpaths can be covered with roof and benches installed there. This will help the underprivileged class who can't avoid being outside.

Courtesy The Express Tribune, April 8th, 2023

GOVT TO HAND OVER SEAPORTS TO UAE

By:

Shahbaz Rana



Sources suggest that the PICT may pose legal challenges based on the concession agreement.

Expects to finalise new deal by the end of June 2023

On Monday, Pakistan constituted a negotiation committee to finalise a deal with the United Arab Emirates (UAE) for handing over its Karachi port terminals. This move may mark the first intergovernmental transaction under a law enacted last year to raise emergency funds.

Finance Minister Ishaq Dar chaired the meeting of the Cabinet Committee on Inter-Governmental Commercial Transactions. The cabinet committee decided to set up a committee to negotiate a commercial agreement between the Karachi Port Trust (KPT) and the UAE government, according to the decision.

The negotiation committee has also been permitted to finalise a draft operation, maintenance, investment, and development agreement under the government-to-government arrangements with a nominated agency of the UAE for handing over the Karachi port terminals, as shown in the decision.

The negotiation committee set up to finalise a framework agreement will be headed by the Minister for Maritime Affairs, Faisal Sabzwari. The committee members include the additional secretaries of Finance and Foreign Affairs, the special assistant to PM Jehanzeb Khan, the Chairman of the Karachi Port Terminal (KPT), and the general managers of the KPT.

Pakistan aims to reach a deal to hand over the terminals to Abu Dhabi Ports (ADP), a subsidiary of the Abu Dhabi Ports Group. The UAE government had shown interest in acquiring the Karachi port terminals that were under the administrative control of the Pakistan International Containers Terminals (PICT) last year.

The PICT is a subsidiary of ICTSI Mauritius Limited, with its ultimate parent company being International Container Terminal Services Incorporated, a company incorporated in the Philippines.

Abu Dhabi Ports, part of AD Ports Group, owns or operates 10 ports and terminals in the UAE.

The PICT operated the Karachi terminals from June 2002 for a period of 21 years, which ended last Saturday. However, under the Concession Agreement, the PICT has the first right of refusal subject to certain conditions.

Sources suggest that the PICT may pose legal challenges based on the concession agreement. The company's CEO was not available for comment.

Last year, the coalition government enacted the Intergovernmental Commercial Transactions Act, aimed at selling state assets on a fast-track basis to raise funds. The country is in dire need of additional money after its deal with the International Monetary Fund (IMF) has lapsed.

Initially, the UAE had refused to provide loans to Pakistan and urged it to sell stakes. However, it later committed $1 billion, which is still undisbursed.

Although the new law provides a fast-track channel to sell the assets, the government may need to engage "transaction advisors or consultants" for price discovery under section 4 (e) of the Commercial Act.

Sources indicate that the government needs to be extra careful when finalising a deal with the UAE, as it will be the first transaction of its kind, and the outgoing operator is also posing some challenges.

Initially, the plan was for the KPT to run these terminals, but the cabinet committee was informed that the KPT does not have the capacity, and the operations of the terminals should be given to the PICT until June 30th.

The government expects to finalise the new deal with the UAE by that time.

A handout from the Ministry of Finance stated that the cabinet committee considered a summary of the Ministry of Maritime Affairs regarding the management of operations of PICT. The cabinet committee was informed that ADP, owned by the government of the UAE, has shown interest in operating the Container Terminal.

The cabinet committee also decided to set up another committee to negotiate the draft framework agreement between the government of the UAE and the government of Pakistan, under the Inter-Governmental Commercial Transaction Act

2022, to further strengthen relations between the two countries in the maritime sector. This committee will be headed by the Secretary of Maritime Affairs.

Sources indicate that the new committee will meet within this week, and there is a possibility that the framework agreement will be finalised at the earliest in order to conclude the deal.

Courtesy The Express Tribune, June 20th, 2023

HIMALAYAN GLACIERS ON TRACK TO LOSE UP TO 75% OF ICE BY 2100

Glaciers in Asia's Hindu Kush Himalaya could lose up to 75% of their volume by the end of the century end due to global warming, causing both dangerous flooding and water shortages for the 240 million people who live in the mountainous region, according to a new report.

A team of international scientists has found that ice loss in the region, home to the famous peaks of Everest and K2, is speeding up. During the 2010s, the glaciers shed ice as much as 65% faster than they had in the preceding decade, according to the assessment by the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD), an intergovernmental scientific authority on the region.

"We're losing the glaciers, and we're losing them in 100 years' time," said Philippus Wester, an environmental scientist and ICIMOD fellow who was the lead author of the report.

The Hindu Kush Himalaya stretches 3,500 kilometers across Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan.

At 1.5 degrees Celsius or 2 C of warming above preindustrial temperatures, glaciers across the entire region will lose 30% to 50% of their volume by 2100, the report said.

But where glaciers will melt most depends on location. At 3 C of warming — what the world is roughly on track for under current climate policies — glaciers in the Eastern Himalaya, which includes Nepal and Bhutan, will lose up to 75% of their ice. At 4 C of warming, that ticks up to 80%.

The Full Picture:

Scientists have struggled to assess how climate change is affecting the Hindu Kush Himalaya. Unlike the European Alps and North America's Rocky Mountains, the region lacks a long historical record of field measurements that reveal whether glaciers are growing or shrinking.

"There was always some uncertainty in the Himalaya — are they really melting?" said Wester.

In 2019, the United States declassified spy satellite images of the region's glaciers dating back to 1970, providing a new scientific baseline.

Further advances in satellite technology in the past five years, alongside bolstered field efforts, have buoyed scientists' understanding of the changes underway. The report draws on data running through December 2022.

"While the knowledge of the Himalayan glaciers is still not as good as the Alps, it's now comparable to other regions like the Andes," said Tobias Bolch, a glaciologist with Graz University of Technology in Austria unaffiliated with the report.

Compared with a 2019 ICIMOD assessment of the region, "there's a much higher level of confidence now in these findings," said Wester. "We have a better sense of what the loss will be through to 2100 at different levels of global warming."

Livelihoods at risk:

With this newfound understanding comes grave concern for the people living in the Hindu Kush Himalaya.

The report found water flows in the region's 12 river basins, including the Ganges, Indus, and Mekong, are likely to peak around mid-century, with consequences for the more than 1.6 billion people who depend on this supply.

"While it may sound like we'll have more water because glaciers are melting at an increased rate ... too frequently it will arise as floods instead of a steady flow," said Wester. Past peak water, supplies will eventually dwindle.

Many high mountain communities use glacial water and snowmelt to irrigate crops. But the timing of when snow falls has become more erratic, and there's less than there used to be.

Courtesy The Express Tribune, June 20th, 2023

INDIA'S IWT LETTER A PLOY, SENATE TOLD

By:

Rizwan Ghilzai

Climate minister says Modi govt wants to use issue to get popular vote in next polls

Lawmakers in the upper house of the parliament have urged the government to effectively respond to the Indian attempt to change the Indus Waters Treaty, a deal brokered by the World Bank between the two rival countries to share the water available in the Indus River and its tributaries.

A number of senators--including Leader of Opposition Senator Shahzad Waseem, Senator Mushahid Hussain Sayed and Senator Kamran Murtaza--on Friday called attention to a notice send to Pakistan via the Permanent Indus Commission (PIC), a bilateral commission consisting of officials from India and Pakistan.

India on January 25 sent the notice to Pakistan seeking renegotiation of the treaty, which governs water-sharing for six rivers – the Indus, Chenab, Jhelum, Beas, Ravi and Sutlej.

Taking the floor, Mushahid Hussain Sayed said Pakistan needs internal unity in order to effectively respond to India. He lamented that the army and judiciary are being targeted and political stakeholders are levelling serious allegations against each other.

Referring to the ongoing political turmoil, he said the coalition government will have to sit down across the table with the Pakistan Tehreek-e-Insaf (PTI) in order to resolve the crisis.

"When we can talk to the Taliban and [Indian Prime Minister Narendra] Modi then why can't we talk to the PTI?"

The senator, who belongs to the ruling Pakistan Muslim League-Nawaz (PML-N), said the government will have to comply with the Constitution and hold elections within the stipulated time.

Senator Kamran Murtaza said the nation will have to first resolve its internal dispute over water sharing and then give a strong message to India.

"We need to protect our water; otherwise we will lose this precious resource," he said.

Murtaza said India violated the IWT earlier and built controversial dams but Pakistan could do nothing except lodging protests.

He said Pakistani officials have in the past shown criminal negligence at various international forums and damaged the interests of the country with regard to its water resources.

"We need to give a strong response to this move by India to renegotiate the IWT," he added.

Responding to the call attention notice on behalf of the minister for water resources, Federal Minister for Climate Change Senator Sherry Rehman informed the house about the contents of the Indian notice.

She said India has accused Pakistan of violating the agreement and committing material breaches while making vague demands for modifying the IWT.

"It seems that the Indian government has raised the issue in an aggressive manner in order to garner public support ahead of the Indian general election," she said.

"Responding to the letter in an aggressive manner will not be a proper strategy as the Modi government apparently wants to provoke Pakistan." She assured the Senate that the government is fully cognizant of the matter and is dealing with it on its merits.

"According to Article XII (4) of the IWT, the provisions of this treaty shall continue to remain in force until terminated by a duly ratified treaty concluded for that purpose between the two governments.

"The WT is the only ratified treaty between Pakistan and India and has not been replaced by a duly ratified treaty concluded between the two governments; therefore, the IWT is the instrument in force and will continue to be in force."

She said it is imperative for India to ensure implementation of the treaty in its true letter and spirit. Rehman said in the past, Pakistan raised objections to the design of Baglihar Dam and challenged legality of diversion of the River Kishanganga into Wullar.

"Presently, Pakistan has disputed India's Kishenganga and Ratle hydroelectric plants and moved the Court of Arbitration to interpret various provisions of the treaty for settlement of systemic issues concerning its interpretation and application."

The minister said that the PIC as defined in the treaty is the appropriate forum to raise and discuss any concerns. Pakistan is, therefore, happy to engage on any outstanding issue regarding the treaty.

"The government has made deliberations with all relevant stakeholders, and a response was sent to India on April 1, 2023, seeking clarification from the Indian side about the contents of their letter. The response has been made while considering the national interests of the country." Rehman said Pakistan is not panicking and is vigilant about its water resources.

"The IWT has survived all kinds of tensions between the two countries and has played a vital role in managing the water resources between India and Pakistan. Pakistan is committed to the treaty and expects India to comply with it," she added.

Courtesy The Express Tribune, April 08th, 2023

PDMA CRAFTS PLAN TO TACKLE HEATWAVE

Warns 1 degree rise in temperature could decrease farm yield by 6%

Khyber-Pakhtunkhwa (K-P) Provincial Disaster Management Authority (PDMA) under the supervision of relief, rehabilitation and settlement department has unveiled a comprehensive heat wave action plan 2023 to mitigate the impact of extreme heat in the province.

The plan was designed considering the adverse effects of climate change and rising temperatures and to assign clear roles and responsibilities to all stakeholders to ensure protection of locals' health, infrastructure and forests.

The action plan was developed through consultations with stakeholders and analysis of past experiences of heat waves in the province.

The plan emphasizes the importance of awareness campaigns to educate citizens about preventive measures against heat strokes and other heat-related illnesses. It highlights the significance of monitoring weather forecasts, tracking heat indices, issuing heat warnings, and activating emergency response teams.

The action plan presents a range of response activities to protect residents from heat-related illnesses and provides guidelines to follow in the event of unforeseen emergencies.

According to the Pakistan Meteorological Department (PMD) seasonal outlook, temperatures are expected to be slightly above normal in the upcoming two months. With the anticipated rise in temperatures, the general public is advised to take necessary precautions to avoid heat stroke.

As per experts the symptoms of heat stroke include high body temperature, loss of consciousness, dizziness, rapid heartbeat and headache.

To protect oneself from heat stroke and other heat-related ailments during heatwave period, PDMA advises the masses to drink plenty of water, wear loose, lightweight, and light-colored clothing to allow better air circulation and reflect sunlight, limit direct exposure to the sun during peak hours, typically between 10 am and 4 pm.

The general public has been directed to take frequent breaks in a cool place, or use fans to lower the body temperature, plan outdoor activities wisely and if engaging in outdoor work, schedule them during cooler parts of the day.

They were asked to monitor weather forecasts and heat advisories and take regular breaks to rest. The heatwave plan also includes provisions for safeguarding public livelihoods.

Instructions have been issued to address the potential impact on agricultural land and products.

It has been observed that if the temperature rises one degree above the normal, agricultural products may experience a loss of up to six percent.

Talking to journalists Director General PDMA Janat Gul Afridi said “We have identified vulnerable populations, such as the elderly, young children, and individuals with chronic medical conditions, and have incorporated specific measures to protect these groups from the adverse effects of extreme heat.”

He further added, “The effective implementation of this plan will significantly reduce the impact of heat waves in the province. The helpline of the PDMA 1700 is functional and can be contacted anytime in case of any emergency.”

PDMA urged all stakeholders to familiarize themselves with the heat wave action plan and understand their respective roles and responsibilities to ensure a coordinated and effective response in the event of a heat wave emergency.

Courtesy The Express Tribune, May 18th, 2023

RETHINK THE RAVI RIVER FRONT PROJECT

While ecological impacts of Ravi river project remain to be seen, its human cost is already becoming apparent

The former government, of Imran Khan, had claimed to champion causes of the common man and the environment. Yet, like many of their predecessors, the PTI also fell prey to vested interests of influential developers and cash-starved provincial authorities by giving the go-ahead to the problematic but lucrative Ravi Riverfront Urban Development Project.

Given approval in mid-2020, the proposed 100,000-acre urban development initiative aims to reinvigorate the dying Ravi river by turning it into a perennial freshwater body, while at the same time undertaking massive urban development on both sides of the riverbank. Moreover, this venture has promised to help address many of the megacity's challenges, including improving waste and sewage management, provision of safer drinking water and catering to the growing demand for housing. The project has, however, been viewed with much skepticism by environmental and other civil society organisations which fear serious ecological damage and severe human displacement being caused by the current design of this project. Environmentalists pointed to the potential danger of changing the flow of the already stressed Ravi river, and encroaching on the river's floodplains, which could significantly increase the risks of flooding.

Moreover, the land needed for this project is not lying vacant. Instead, over eighty per cent of it is estimated to be in use for agricultural purposes, which in turn provides food to the residents of the city, besides offering a source of livelihood for hundreds of thousands of farmers and agri-labourers. Nonetheless, according to the Ravi Urban Development Authority, which was created to manage this ambitious plan, the proposed project has already drawn $8 billion of Chinese investments. The first phase of RUDP was said to also include a somewhat meager budget of Rs200 million for land acquisition. While longer-term ecological impacts of this venture remain to be seen, the human cost of the Ravi river project is already becoming apparent. According to the Human Rights Watch report released this past month, provincial authorities have allegedly begun evicting farmers.

To help expedite the Ravi River project, the current provincial government is reportedly using draconian colonial laws (such as the Land Acquisition Act of 1894) to help the private developers acquire needed property. Affected farmers challenging the legality of the land seizures are apparently facing intimidation and criminal charges, even though their legal challenges to being evicted are still pending before the courts. The Lahore High Court declared the Ravi river project to be "unconstitutional" in early 2022. The Supreme Court overruled this decision, and merely asked the government to engage in development work on land which had been acquired with the consent of its former inhabitants. Yet, allegations of more land being acquired through coercive means have not subsided. Even those who have been compensated for being displaced complain that they were not paid a fair market share for their property. This claim is not surprising given that government

entities have frequently used their power to purchase land in the name of ‘public purpose’ at well below market rates.

Using this unbridled authority to dispel residents and obtain required land for pricy urban development projects has enabled many property tycoons and other vested interests to make a lot of money. Yet, the resulting urban sprawl has come at a serious human cost, and resulted in encroachment on agricultural land, which is not good news for food security. Then there are the lingering ecological threats associated with the Ravi river project which were hardly alleviated by a rushed environmental impact assessment undertaken for this project. Given the massive scale at which this contentious project is meant to be implemented, its resulting human and ecological impacts could unleash devastating consequences which will not be easy to manage in retrospect.

Courtesy The Express Tribune, May 27th, 2023

SCIENTISTS DISCOVER LIFE SUSTAINABILITY ON SATURN

By:

Suhail Yusuf

Dr Nozair Khawaja, a Pakistani-born scientist, played a crucial role in the groundbreaking achievement

In an extraordinary breakthrough, an international team of scientists led by Professor Frank Postberg at Freie Universität Berlin has discovered a key ingredient for life beyond Earth. Dr Nozair Khawaja, a Pakistani-born scientist, played a crucial role in the groundbreaking achievement.

Through their tireless efforts to uncover the secrets of the universe and search for extraterrestrial life, the team focused their attention on Saturn's icy moon, Enceladus.

Analyzing data gathered from NASA's Cassini space mission, they made an astounding revelation. For the first time ever, phosphorus, the rarest element critical for life, was detected in an extraterrestrial ocean beneath Enceladus' surface.

The study was published in the scientific journal Nature on Wednesday, June 14, 2023.

"The results show the presence of substantial quantities of phosphates in Enceladus’s ocean water and our geochemical experiments tell us why its ocean is so enriched with this essential compound compared to Earth's ocean,” Professor Postberg said in an email to The Express Tribune.

Phosphorus makes the skeleton of DNA, RNA and fertile soil on Earth. The addition of Phosphorus completed the checklist of elements essential for life, thus making Enceladus the most habitable candidate of life after our blue planet.

"With the discovery of phosphates, Enceladus has revealed the full squad of all six bio-essential elements (C, H, N, O, P and S) required for life", said Dr Nozair Khawaja, the coauthor of the study.

Phosphorus is essential for all life on Earth to build DNA (and RNA) and a limiting factor for the growth of life in different environments on Earth. This element in the form of phosphate is crucial for life as we know it on Earth.

"With this stunning breakthrough discovery, Enceladus has become a prime body in the solar system to search for extraterrestrial life. As a result, a new space mission equipped with modern technology needs to be sent to determine whether this extraterrestrial habitable ocean world is truly inhabited," added Khawaja while speaking to The Express Tribune.

Enceladus, the sixth-largest moon of Saturn, has a modest width of only 500km. The valuable exploration of this intriguing moon was made possible through the dedicated efforts of NASA's Cassini spacecraft, which successfully reached the ringed planet in 2004.

Over the course of its mission, Cassini captured a staggering 453,048 images of Saturn and its moons, conducting 162 targeted flybys of Saturn's moon and even unveiling the existence of six new moons.

Courtesy The Express Tribune, June 19th, 2023

PROMOTING SUSTAINABLE DEVELOPMENT IN PAKISTAN WITH GREEN FINANCE

By:

Zahid Sultan Jadoon[1], Shahid Usman[1], Sohail Ali Naqvi[1] and Rashid Ahmed[1]

Abstract

Through years, different environmental issues have arisen due to increased industrial development. In order to deploy solutions for these problems, the idea of Green Finance was offered which foresees that the linkages for both public and private sectors should be created for technological advancement and sustainable economy. Since then, each country has been focusing on implementing green finance policies. Nevertheless, the procedures related with adopting the new approaches of financing in advanced countries are relatively to adopt when compared with developing countries. Recently sustainable policies for banking have been introduced by the State Bank of Pakistan with the objective of reduction in the susceptibility of banks from environmental aspects, accomplish their obligations for shielding the environment, and providing the finances for innovation of the economy. This article has provided thorough analysis on green finance mechanism for green progression in Pakistan by discovering the logistics (supply-side) of the approach for green banking that covers many problems confronted by banks or DFIs, and the demand-side, which is related to the acquiescence of sustainable banking practices by the debtors. It also provides assessments on the policies for initiation of green finance that have been implemented and describe that formulation and implementation of these practices in China and India is much better while Pakistan is the initial phases of development and formulation of its sustainable Banking approach and the suggestions for the application of such polices are provided in this study.

Keywords: Ecological Inequality, Green Finance, Supply & Demand Side, Banking Sector, Fossil Fuels.

Introduction

Since the development of Industries, ecological disturbance has directed to high concentrations of carbon dioxide (CO_2) and other Greenhouse Gases (GHG) which ultimately created various environmental issues worldwide. The environment is being affected by contamination, global warming, depletion in ozone layer, reduction in natural resources, cutting of trees, and diversity loss with the initiation of technological advancements. Fast and disproportionate industrial development has caused additional problems related to environment, water and health due to lack of precautionary actions for protection of the environment as well as mishandling of industrial projects.

[1] World Wide Fund for Nature Pakistan (WWF-Pakistan)

Market activities associated with manufacturing and consumption, and roaring population development has seriously influenced the Climate change and environmental degradation by their negative impacts. The social costs have been created due to stages of modern production which results in air and water pollution. Market forces have heavily driven the advanced patterns of consumption deprived of attention to fundamental ecological demands. In 2010, a critical assessment on overall consequences of energy-based CO_2 emission globally by International Energy Agency (IEA) and concluded that fossil fuel-oriented energy and climate safety challenges were considered as serious problems affecting green economic growth. A case study was conducted in China which indicated environmental issues that triggered grave consequences. The prime reason for excessive air pollution rate in China is due to its rapid economic growth among the major countries over the past two decades. Throughout the world, 16 out of the 20 utmost polluted cities are situated in China. Due to this extensive air pollution, China's Ecological Sustainability Index is graded close the bottom amid the countries at global level. To fight with these problems, a comprehensive strategy has developed by government of China to cope with pollution by industries to the environment

Environmental impacts due to industrial advancement are being better managed by developed countries because the business procedures are established and need devotion. While the fact is that the universal ecological disaster is tempted by gigantic consumption of resources and energy in advanced countries, the worldwide environmental disaster is also disseminated by deprived rules and procedures in developing countries. When connections with developing countries are recognized through global trade, they also participate in environmental issues globally. The extent of environmental problems is significantly elevated in developing countries because of non-compliance of the regulations related to business, largely including (a) discarding of waste produced by industries; (b) use of obsolete machinery; (c) inappropriate upkeep of plants and equipment; and (d) absence of answerability from leading figures.

Global Climate Risk Index recognized a list of the utmost influenced countries with help of 1997 to 2016 dataset of extreme weather situations and socioeconomic conditions which included: Honduras, Haiti, Myanmar, Nicaragua, Philippines, Bangladesh, Pakistan, and Vietnam. The outcomes also demonstrate that Haiti, Zimbabwe, Fiji, Sri Lanka, and Vietnam were most affected countries by weather and climate change in 2016 as they recorded as great risk countries on the Index. The investigation also described that due to lack proper compliance with appropriate procedures to protect the environment, developing countries are usually more influenced by high risks of climate as compared to developed countries leading severe issues.

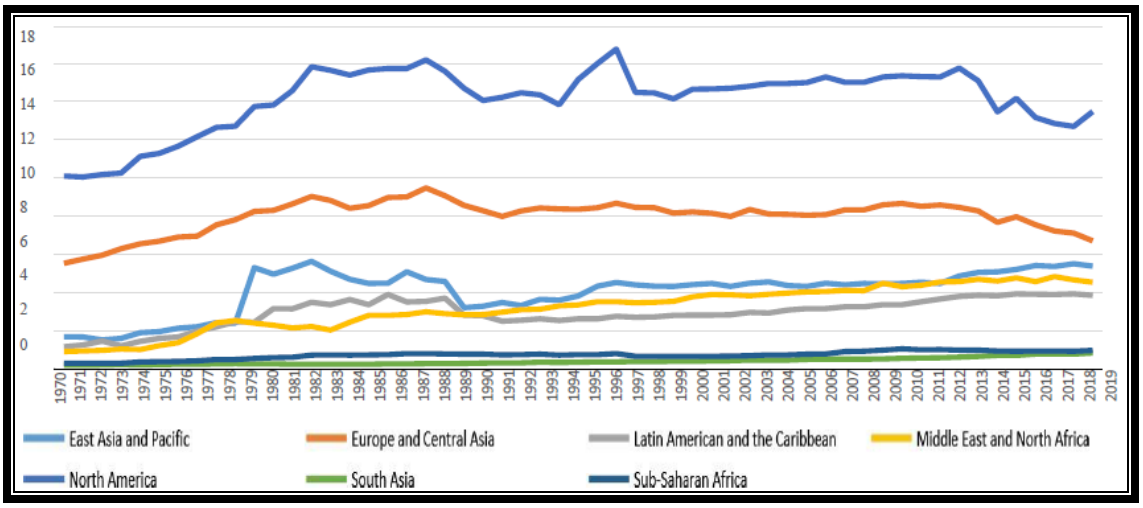


Figure-1: CO_2 Emissions (Metric Tonnes Per Capita)

Source: World Bank, "Data Indicators," https://data.worldbank.org/indicator/en.atm.co2e.pc.

Figure-1 indicates the CO_2 emissions level (metric tonnes per capita) around the world from 1970 to 2020. For the measurement of the CO_2 emissions levels in these areas, average of a metric tonnes per capita between all countries is used in this study. This graph demonstrates that a elevated level of GHG would reduce the likelihood of environmental protection. Each person's CO_2 emissions related to energy use depends on numerous factors such as energy mix, economic development, efficiency, and personal patterns of energy consumption). North American nations (Bermuda, Canada, and the US) have produced more CO_2 emissions per person over the past 55 years, which is a reflection of the decline in environmental quality caused, among other things, by improper industrial waste disposal, unfit vehicles, procedural violations, and a lack of respect for the law. Figure-1 shows that Europe and Central Asia are in second place, although it appears that environmental protection has declined because of greater CO_2 emission. Latin America and the Caribbean, East Asia and the Pacific, and the Middle East and North Africa have low concentrations of CO_2 emissions Due because of less manufacturing activities that minimize pollution. Lastly, the lowest per capita CO_2 emissions are found in South Asian and Sub-Saharan African nations. In order to combat environmental degradation, the idea of "green finance" was introduced, which calls for both the public and private sectors to create connections between technological advancement, innovation, and the greening of the economy in order to uncover untapped potential for economic growth. In order to accomplish its goals, it is crucial that organizations and governments take the necessary steps to impose the necessary regulations and implement penalties for non-compliance.

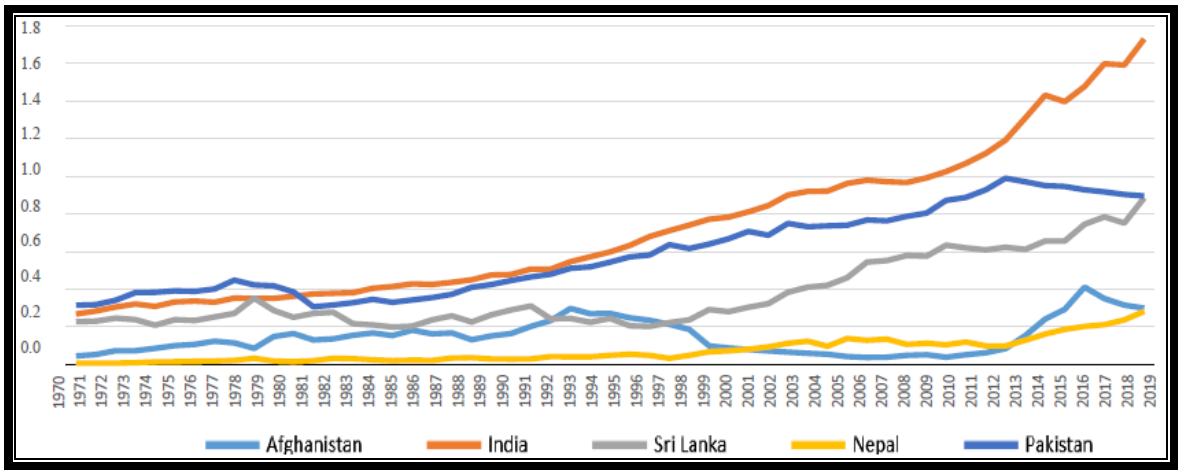


Figure-2: Country-wise Position of CO2 Emissions (Metric Tonnes Per Capita) in South Asia

Source: World Bank, "Data Indicators,"

This research separately examines the effects of CO_2 emissions on each of the countries in South Asia in order to assess the level of emissions in metric tonnes per person. Figure-2 illustrates the amount of CO_2 emissions in five nations from 1970 to 2020, including Afghanistan, India, Nepal, Pakistan, and Sri Lanka. Figure-2 demonstrates an increase in CO_2 emissions per person, indicating a connection between population growth and GHG emissions. In the case of India, CO_2 emissions per capita grew from 1.0 to 1.76 metric tonnes during 2000 to 2020s. Pakistan ranked second while Sri Lanka was third. The findings imply that these nations' governments should devise and put into practice the laws requiring residents to abide by environmental quality standards. The figure also shows the CO_2 emissions in Afghanistan and Nepal, indicating that these nations are dealing with less environmental and climatic problems. In general, procedural challenges and a lack of knowledge about environmental protection are significant factors that may elevate the threats associated with environmental issues among South Asian nations in relation to CO_2 emissions.

A comprehensive approach is needed due to the severity of environmental concerns in many countries and regions. In order to achieve "green" growth, the concept of "green finance" emphasizes the importance of the financial sector's involvement in reducing adverse environment circumstances. This is done through funding environmentally friendly organizations. The first Green Bank opened its doors in 2009 in Mt. Dora, Florida, USA, giving rise to the idea of green banking. Green Finance is difficult to define in a simple way. The banking sector then developed its green banking strategies to support both green development and green finance.

As the integrity of their environments has degraded with passage of time, advanced countries have realized the value of green finance. Researchers have examined green banking regulations in countries including Bangladesh, China, India, Romania, Poland, and Vietnam to determine the opportunities for growth of a green economy.

Green Banking Guidelines have been formulated by the State Bank of Pakistan (SBP) to encourage eco-friendly initiatives through funding various economic sectors. All banks and development financial institutions (DFIs) are developing

procedures to ensure that borrowers may be evaluated before and after receiving money in order to ensure that they satisfy the requirements established to achieve Green Finance reforms in order to comply with the SBP's directions.

This article's goal is to evaluate the green banking policy from both the supply (banks/DFI) and demand sides (borrowers), looking at how green finance works for sustainable development in Pakistan and other developing nations. In order to effectively use green finance, both banks and borrowers need to get a thorough grasp of green policies and comprehend how this mechanism may be made stronger over time. This study's comparison of Green Finance programmes and regulations in developing nations is one of its secondary goals. It has been shown that China and India are far more adept at developing and putting into practice green banking regulations that would aid them in reducing environmental challenges. Pakistan's green banking regulations are still in the early stages of development as banks and DFIs work to create them. Therefore, it will take some time for them to gain from these programmes.

Green Finance - An Overview

Green Finance is an important factor for attaining green growth, which is defined as "balanced economic growth"- a necessary component to attain sustainable development. According to another researcher, driving force for "green" is to attain patterns of economic development by offering eco-friendly growth chances.' the European Centre for the Development of Vocational Training states that both private and public sectors are necessary to build links between technical progress, innovation, and sustainable development of the economy that presents unexplored prospects for economic growth ' Environmental innovation has a favorable impact on competitiveness and productivity, which may serve as a catalyst for lowering economic costs and achieving ecologically sustainable growth. In a recent study, the World Bank Group analyzed green finance initiatives through a survey which covers the assessment of financing proposals, evaluation of actions taken to attract Green Finance, and environmental, social, and governance (ESG) risk managementintegration. The respondents largely classified Green Finance on the basis of biosystem adaptation, energy efficiency, environmental protection measures, renewable energy, sustainable land management, recycling and waste management, and water efficiency.

To make the connections among Green Finance and green development, governments are obliged to encourage and legalize green industrial markets by promoting green technology, products and consumption. With the help of green finance, firms may generate funding to investigate new business opportunities and proposed green technologies. when weak green finance systems will not encourage a green industry then green product will exit the market as a result of losing public interest. This might make it harder for economies to 'go green' on a wider scale. The financial sector must develop new financial products in order to meet the goal of green finance, and then focus on the necessary financing for industries and technology. These initiatives will result in green development by creating new technologies, encouraging sustainable industries, and designing an effectiveemissions trading plan. The Green Finance Initiative (GFI) was introduced in Londonin January, 2016. The purpose was to raise awareness about Green Finance

and promote definite governing and strategy plans which may aid green finance worldwide. Asian financial institutions are still underrepresented in sustainable finance activities, as indicated by the fact that just 122 of the 1874 signatories to the Principles of Responsible Investment commitment, which comprise asset owners, investment managers, and others, are from Asia. The Green Finance Study Group highlighted barriers to green finance activities in developing nations from an institutional and commercial perspective. The study group focused on financial system institutional and market hurdles that prevent enough private green investment from being mobilized in sectors like pollution management, renewable energy, green transportation, and energy- effective products. The group also pinpointed a few crucial elements that improve the overall process, including as:

- greening institutional investment;
- risk analysis; and, measuring progress.
- greening the banking system;
- greening the bond market;

Currently, banks in the majority of developing countries are unable to assess borrowers, and the absence of "green" performance evaluation seems to be a barrier. Another obstacle for developing economies is the development of novel products like green bonds Investors may lost trust if there isn't a clear, comparable explanation, and excessive costs and unpredictability may cause issuance problems. The other drawback is a scarcity of disclosure requirements and inadequate Environmental Impact Assessment (EIA) capability that would make it impossible to fully include important aspects in the decision-making process for investments. Additionally, banks and DFIs in undeveloped countries may fail to effectively incorporate environmental concerns into their financial decision-making procedures.

Mechanism of Green Finance for Sustainable Development in Pakistan

The environmental and climate challenges in Pakistan are first discussed in this section, after which the SBP's planned green finance policies are covered, including both supply and demand side aspects.

Environmental and Climate Issues in Pakistan

Pakistan is confronted with several environmental concerns that pose serious dangers to human health and life. According to a survey, the energy (with a 51% share) and agriculture-livestock fields are the country's largest contributors to GHG emissions. According to the analysis, climate finance is a key element that will drive companies toward low-carbon mitigation solutions. As a result, funding tools are needed to promote climate finance in the country.

A previous study evaluated the link between per capita carbon emissions, revenue, energy usage, and international trade in Pakistan from 1972 to 2008, and found a quadratic long term association between carbon emissions and revenue. Additionally, it discovered that per capita carbon emissions and international trade have contributed to a rise in emissions in the country. In another study, researchers examined the co-integration of carbon emissions, energy usage, trade openness, and economic development in Pakistan from the year 1971 to 2011. They

discovered an inverted U-shaped relationship among GHGs emissions and energy usage by setting 640 kg of oil equivalent as the standard for energy use per capitThey also highlighted the fact that the economy is now operating below this standard and the carbon emissions are anticipated to gradually multiply over time until the standard is achieved. Chang found out that excess or spare CO_2 emissions of a specific nation to determine the concerns associated to CO_2 emissions. He rectified CO_2 emission of every country for forign trade to create CO_2 redistributing and carbon appropriation via forest resources to establish their net CO_2 emissions. He stated that nations with higher and lower gross per capita CO_2 emissions than the average had a surplus and spare emissions, respectively.

Pakistan has been ranked as one of the top 10 countries most affected by climate change. Climate change has a negative impact on the country's health, agriculture, and general economic activity. The key causes are consisting of CO_2 emissions, population growth, forest degradation, and a shortage of resources to reduce and implement the consequences of climate change. Water shortage is another issue that arises in the country as a result of climate change, a lack of enough reservoirs to store water, and outdated irrigation practises. Air pollution has an impact on the environment in Pakistan as well. This is due to the discharge of hazardous gases from industry, brick kilns, and transportation vehicle. Another major challenge is waste management. Industrial sectors and hospitals dump their waste into the ocean, lakes, and rivers, endangering aquatic and human life that rely on these water resources. These issues develop as a result of ineffective waste disposal procedures. Green Finance Policies in Pakistan

In accordance with global guidelines, the SBP established a basic structure for incorporating sustainable banking in Pakistan in 2017 which aims:

To minimize the susceptibility of banks and DFIs (development finance institutions) from environmental risks, perform their duties for environmental protection, and offer funding to change the economy that would be resource-efficient and climate-resilient. The International Finance Corporation (IFC) has acquired an advisory contract with the SBP to promote sustainable banking in Pakistan which is component of the IFC's commitment to assist nations in making the transition to green, low-carbon, and sustainable economies. The IFC will assist in improving environmental risk management processes and ensuring ethical lending practises in this context. Banking guidelines primarily focus on risk management systems established to monitor, investigate, and analyze environmental hazards that might be generated from economic activity after banks allocate funds in order to avoid environmental difficulties. Environmental hazards associated with funding portfolios of banks and DFIs are the ones that are triggered by their debtors' transactions. These hazards may have an immediate impact on production-related activities as well as the environment in the long term. This creates uncertainty and partial or total revenue losses for banks/DFIs. The goal of adopting Green Finance is to guarantee that banks/DFIs follow an Environmental Risk Management System (ERMS), which may assist to reduce environmental hazards. This system usually comprises of discovering risk factors, the parameters that cause risks, the assessment of significant risk implications, and the evaluation of risk reduction factors. The next paragraphs provide a quick summary of them.

Environmental Due Diligence

Environmental due diligence is a systematic procedure for evaluating environmental issues and their influence on the merit attributes of a specific funding transaction at the first assessment stage, as well as to offer subsequent assessments of the borrower's performance and creditworthiness. This procedure assesses the compliance of borrowers with environmental rules. The Pakistan Environmental Protection Act of 1997 provides protection to the environment. The provisions of the Protection Act make it clear that every project must undergo an initial environmental assessment to guarantee that this novel development does not harm natural resources, particularly freshwater. Under this Legislation, the Environmental Protection Agency (EPA) was founded to devise laws, guidelines, criteria, and instructions to safeguard the environment. The goal of this approach is to identify the elements that might mitigate negative environmental consequences after doing a Cost and Benefit Analysis (CBA) for using environmental assets in the suggested projects.

To investigate environmental compliance in Pakistan's textile sector, researchers used stratified random sampling to survey 60 big and medium textile manufacturing plants. Regarding compliance with environmental legislation, they stated that 87% of enterprises used more than two environmental management strategies, 50% used more than five, and 12% used all nine guidelines. They also discovered that major enterprises used different environmental procedures than modest firms in order to meet international rules.

The due diligence procedure identifies the environmental risk criteria and also examines the severity related to the risks as well as the probability of significant harmful results. The assessment of environmental aspects includes provisions for creating a framework for developing certain fundamental concerns of any environmental hazard that might be implicit in the use of borrowed funds.

Environmental Risk Rating

In terms of environmental risk gradings, the evaluation of environmental factors comprises seriousness, significance, persistence, and acquiescence with legal demands; hence, banks/DFIs can estimate the likelihood of harmful environmental incidents. It is also critical to utilize both qualitative and quantitative approaches to assess the extent and possibility of the impacts of these environmental threats. To offer more considerate green economic alternatives, the environmental risk assessment linked with these particular features may be combined with the conditions of financing, kinds and sizes of consumers, and specific industry. As a result, banks/DFIs may use a statistical technique to obtain a single consistent evaluation of the funding suggestion. The association among environmental due diligence and risk rating is illustrated in Table-1.

Table-1

Relationship between Environmental Due Diligence& Risk Rating

Due Diligence	Risk Rating
■ To comply with environmental rules	■ Findings of due diligence formulaterisk rating
■ To follow sector-oriented criteria	■ To identify risks at various level
■ To conduct non-technical due diligence	■ Consequences of risk rating

Source: SBP, "Green Banking Guidelines," State Bank of Pakistan (2017), http://www.sbp.org.pk/smefd/circulars/2017/C8-Annex.pdf.

Due diligence and risk rating aid banks/DFIs in monitoring, reducing and managing environmental hazards via standard decision-making procedures, environmental upgradation programmes, and environmental hazard measures in financial contracts with debtors. Questions emerge over how this system contributes to the overall process. For systematization of the credit acceptance procedures, Banks/DFIs may design an organization chart that includes multiple levels for evaluating the potential exposures and environmental hazards linked with the particular funding.

Considering the seriousness of the environmental hazard, they can reach to an agreement with the debtor on an Environmental Improvement Plan (EIP) with a specific timeline that specifies essential activities and procedures for the debtor to perform as a pre-condition for financing approval. The goal of EIP is to reduce the risk linked with a transaction while yet reaching a satisfactory level for funding. There might be a chance that a debtor's environmental risk could be modified after financing approval owing to changes in the business structure, activities, or obligations of relevant environmental legislation. Banks/DFIs should contend on periodical evaluations with debtors in order to provide a logical statement of ongoing compliance with environmental parameters.

The corporate finance department independently reviews a borrower's application, taking into account the relevant due diligence and risk rating criteria. The legal department also guarantees that the borrowers sign a loan agreement and that the extent of environmental protections is described in the condition precedent and stipulations. A frequent assessment is necessary to determine if the borrower is compelled to meet the terms and conditions of financing contracts in order to monitor financing operations.

Facilitation under Green Banking

Green banking is a systematic technique of environmental risk management which provides a provision for banks/DFIs to introduce new products and markets like energy efficiency, carbon markets, and green mortgages, etc. A well-defined structure of financing facilities for environmental projects will help banks to develop an image of the environmentally cognizant firms, and also facilitate developing conducive relationships.

Green banking is a methodical approach to managing environmental risk that allows banks and other DFIs to launch new markets and products including energy efficiency, carbon markets, and green loans, among others. A well-explained structure for funding opportunities for sustainable projects will aid banks in creating beneficial partnerships with companies that care about the environment.

Supply Side of Green Finance

As a result of the introduction of sustainable finance in Pakistan, banks and DFIs are now in charge of disbursing funds following the mandatory debtor approval. Following the completion of the borrower's due diligence, a cumulative risk rating is assigned in accordance with the guidelines of green banking. Funds are released after receiving credit department clearance. Conversely, clauses that hold the borrowers responsible for fulfilling the terms of the financing agreement need to be incorporated, and the credit department will periodically examine the procedure.

The procedure for assessing borrowers' environmental risk is depicted in Figure-3. Generally, a project's funding is regularly monitored, but it might be challenging to assess environmental risk since banks and DFIs are obliged to hire specialised staff to offer comprehensive input on the progress of the funding projects. Thus, banks/DFIs should specify the particular criteria to be employed in the monitoring and evaluation procedures on which debtors are rated. Projects are divided into small- and large-sized groups, but it would be challenging for banks to understand the environmental concerns for numerous projects. As a result, external specialists are needed to determine the likelihood that the borrowers will break environmental laws, which ultimately raises the transaction's costs. The SBP should establish a procedure that is implemented in all aspects to analyse the borrowers' business operations since this cost rise forces banks to prevent from the hazards associated with evaluation.

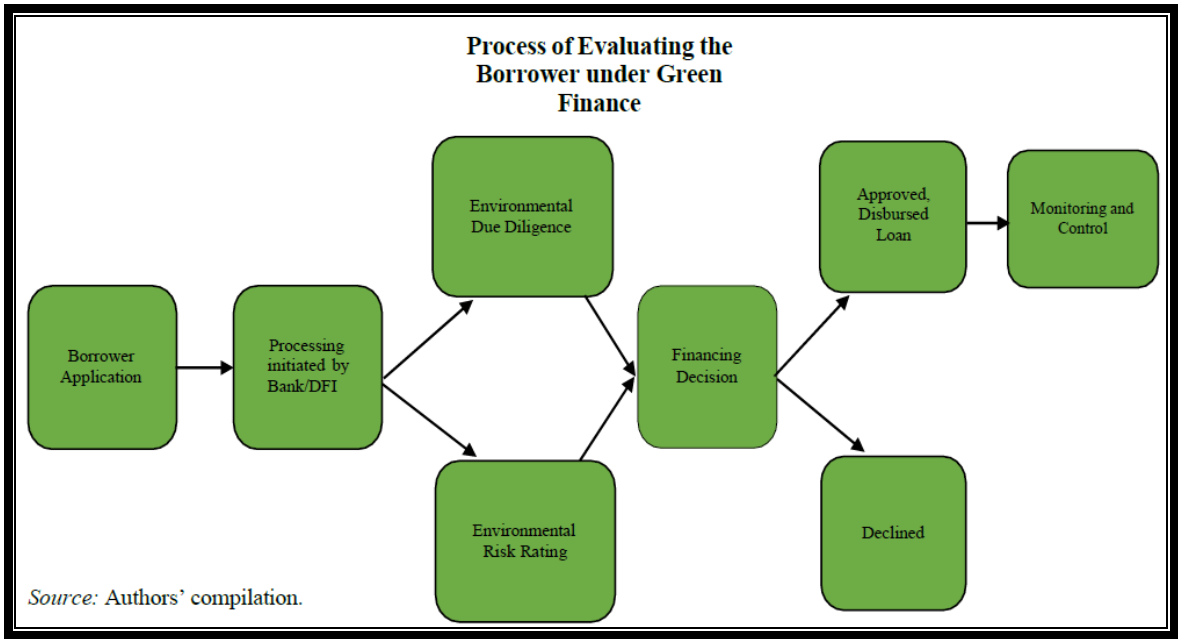


Figure-3

The Board of Directors of banks and DFIs create Green Finance policies inside their respective organisations to strengthen the process. The highest exposure restriction may also be established for industries with higher environmental risks. In addition, Green Finance plans must to be reviewed and approved by the Board of Directors. Management should designate a representative to oversee and evaluate the associated activities as part of the implementation of green banking. It is significant to mention that the green banking officer should be competent for environmental risk evaluation and monitoring, the development of green products, and resource-saving operational improvement techniques. Regular reporting on the environmental risks that are inherently present in the bank's or DFI's portfolio, as well as the business lines' compliance with pertinent environmental rules, should be the responsibility of the risk management department. It appears that there is no market for the expertise needed to supervise this process and recognise the environmental problems. For the helpful assessment of the risk level of debtors and the decision-making process

of loan allocation, all banks and DFIs should train their staff members in environmental risk assessment and due diligence.

Banks find it challenging to comply and offer ecologically risk-free Green Finance. The dynamics of business might shift over time. In a specific context, the question of how all banks can take the essential actions to address environmental concerns over the long term of Green Finance may arise. Despite the fact that the SBP is fully aware of this reality, implementing Green Finance rules in all banks/DFIs would eventually assist to improve environmental circumstances. However, tight and periodic inspection is essential to ensure that borrowers' projects do not violate Green Finance standards. To enable and encourage banks and firms to float green bonds, it is necessary to increase capacity and set policies for their issuance. This potential source of funding will advance green finance in Pakistan. A framework must be developed by the Securities & Exchange Commission of Pakistan (SECP) for organizations that assist with green initial public offerings (IPOs). The framework for communicating and recognising environmental performance in public markets will be strengthened by these IPOs. In a similar manner, the government may launch a programme of green funds that would encourage the growth of green sector funds through Public-Private Partnership (PPP) agreements. It is crucial that the government become involved in creating green bond, green IPO, and green fund rules that will aid the relevant organisations in taking the required actions and foster trust among businesses and investors. The introduction of "green technology," which might aid in understanding environmental challenges, is another goal of green finance. From a critical perspective, it is virtually difficult for all businesses to adhere to the guidelines and implement the concept of green technology. According to Green Finance, every company must adhere to environmental regulations. The borrower may go to another bank that is not rigorously implementing the preconditions of financing if a bank decides not to give a mortgage to a debtor because of non-compliance with environmental regulations. Public, commercial, and international banks all exist in Pakistan, and their goal is to disburse money based on whether or not a borrower satisfies the requirements for receiving finance. The SBP should develop policies that can be enforced consistently so there is "no client effect."

Second, it's crucial that the SBP establish guidelines for all banks and DFIs about how to evaluate debtors in a straightforward and simple way.

Third, the suggested legal cases have no specified framework that highlights how to operate these cases. The petition should be reviewed by a conflict resolution authority, which can then take the appropriate actions to arbitrate any issues.

Fourth, it is challenging to secure green financing to promote green growth throughout the nation, not just in Pakistan but in other emerging nations. Since it is challenging for banks/DFIs and borrowers to abide by the regulations, this raises questions about how regulators can implement and oversee them. Lastly, training personnel at banks and DFIs to make them capable of assessing prospective debtors is associated with significant cost.

Demand Side of Green Finance

Financing is essential for green businesses to develop operations since it enables them to acquire land, buildings, plants, machinery, and equipment. According to the Green Banking Policy, businesses must continue operating while adhering to the rules established by environmental regulations. The first issue that this study anticipates is their incapability to follow the processes due to the various firm sizes. According to this regulation, it appears that small businesses may not be able to lend funding to start up new businesses or extend existing ones. Second, organizations lack knowledge about the implementation of environmental practices so they do not go against corporate policies. The Green Finance Strategy has only been in effect for a little over two years, thus SBP must inform the appropriate parties to make sure that protocols are followed.

Third, the SBP should declare an interim phase of implementing regulations so that organizations may be ready to face these difficulties. According to this report, this phase should last at least two years to provide organizations enough time to meet the requirements for receiving funding from banks and DFIs. Fourth, while the whole Green Finance process is centered on lowering GHG emissions, there is no mention of how to lower CO_2 emissions by businesses in the legislation. This suggests that either full coverage is necessary or CO_2 emissions can be lowered gradually. The SBP should draw attention to these issues so that all relevant details may be worked out and executed to better the country's environment.

Last but not least, banks and DFIs are obligated to provide their staff with the necessary training so that they can monitor their projects and businesses and evaluate if they are abiding by the law. In the case of any shortcomings, they can direct clients to take the necessary steps to resolve the pertinent problems. It is difficult for the firms to comply with these laws practically. A system should be established so that the Green Finance Policy's provisions may be implemented by businesses. Banks and DFIs use environmental due diligence and risk grading system to assess a lender. If they are not satisfied, the application cannot be processed, which shows that the lender is not clearly aware of how to apply and comply with the regulations. In this respect, SBP could host seminars at the level of sectoral organizations and Chambers of Commerce & Industry so that the affected businesses may learn about the policies that would ultimately help the State Bank accomplish its goals. By sharing information, this might also aid in closing the gap. By sharing information, this might also aid in closing the gap among both banks and potential debtors.

Overview of Green Finance Mechanism in DevelopingCountries

In recent years, the idea of "green banking" has become more widely accepted, especially in developing nations where economic development and growth are prioritised over environmental conservation. All nations felt the need to update their financial systems in the wake of the 2008 Global Financial Crisis in order to improve their ability to bear losses. The field of green finance has arose as a model for the future of banking, establishing the connection between a green economy and sustainable development, in order to tackle the problem of sustainable development.

This section analyses and contrasts the green finance regulations in emerging nations. China was the first country to pioneer and support green finance. In the

beginning (2007-2010), China developed "green credit policies" to encourage banks to finance environmentally friendly renewable energy projects. The first type of green policy laid the groundwork for the nation to have sustainable banking. During the consolidation phase (2011-2014), several initiatives were undertaken to develop credit information systems and green finance norms. The China Banking Regulatory Commission then issued a directive for the transparency of green financing that included a provision for green credit responsibility. Most of the research proposals about green finance that were submitted during the implementation period (2015-present) were accepted. The China Society for Finance and Banking established the Green Finance Committee in collaboration with other qualified organisations to advance green finance via adherence to required standards, creation of assessment frameworks, analysis of environmental risks, and capacity development.

Green finance's importance and significance in India have been emphasised by numerous researchers. They claimed that green finance encourages eco-friendly behaviour and lessens the carbon footprint of banking operations. The State Bank of India launched a Green Channel in 2010 as part of its commitment to support environmentally friendly corporate practises. According to the State Bank's instructions, terms and conditions relating to environmental hazards have been introduced to banking policies for assessing prospective borrowers and taking into account whether they engage in environmental-related activities or not. On the plus side, since 2015, green bonds have been created in India to boost green energy. In summary, banks and DFIs are taking the necessary steps to include all the criteria for evaluating loan transactions, However, there is still more work to be done before their green policy objectives can be completely implemented.

Table-2

Comparison of Green Finance Policies in Developing Countries

Country	Guidelines	Approach	Development
Bangladesh	2011	Implemented a comprehensive green finance policy to safeguard environmental degradation and ensure sustainablebanking practices. Banks have included environmental and climate change risk as part of existing risk methodology to assess a potential borrower. They are also setting up green branches which	The policy was divided into three phases. In phase I, banks/DFIs have to develop green banking policy. Phase II suggests formulating sector-specific environmental policies, green strategic planning, setting up green banks and improvedin-house environmental management. In phase III, banks/DFIs are expected to address
		is an integral part of the green policy.	the entire ecosystem by assessing environmentally friendly initiatives and introducinginnovative products. The time frame to apply the above phases has lapsed, however, banks/DFIs are in different phases to comply with these rules.
Brazil	2014	The Central Bank of Brazil passed a mandatory resolution onsocial and environmental responsibility for financial institutions. Banks are required to engage in E&S stress testing and include E&S into capital requirements in line with the Internal Capital Adequacy Assessment	Detailed guidelines exist for the implementation of the socio-environmental responsibility policy by all financial institutions authorised to operate by the central bank. Most ofthe banks are now including E&S risk into their reporting andrisk management strategies.

		Process. Banco do Brazil also formulated a general framework fortypes of risks that should be included.	
China	2007	China's green credit policy laid the foundation for sustainable banking. In 2009, China Banking Association took environmental responsibility in supporting national industrial and environmental policies. Afterward, China Banking Regulatory Commission described the responsibilities and accountability of bank's management ingreen credit, which requires full disclosure of green credit information.	In an initial phase (2007-10), China formulated credit policyfor green financing. In the consolidation phase (2011-14), it established green financing policies and green credit information systems. In the implementation phase (2015 till now), the country has been putting a lot of efforts in R&D, green finance standards, and environmental risk analysis.
Egypt	2014	The Federation of Egyptian Banks is focusing to consolidate its institutional approach towards sustainability and to support the efforts of comprehensive development in economic, social and environmental levels. Subsequently, a Commission has been established to oversee adherence to thebest international practices.	To achieve the purpose of green finance, Egyptian banks arepresently transforming their banking policies so that ESG objectives can be achieved.
India	2010	The State Bank of India introduced the Green Channel as an initial step of green banking. The State Bank included terms of environmental risks for assessing the borrowers. Banks are generally following industry-led voluntary green lending guidelines. An important milestone is that green bonds were issued to support green energy in 2015.	As per the directives of the State Bank of India, banks/DFIs have taken necessary measures for green banking in terms ofpolicies as well as the branch banking. However, a lot more efforts are required to make this process rigorous.
Indonesia	2014	Developed a roadmap for sustainable finance (2015-19) which illustrates the detailed description of green lending. Bank Indonesia and Otoritas Jasa Keuangan have engaged in organising capacity building, working on environmental & social risk and green lending with the financing sector.	With regard to development, commercial banks are not properly engaging in environmental and social risk or greenlending. In terms of mandatory requirements, banks are required to apply them properly and make progress.
Mongolia	2014	The approach emphasizes on achieving sustainable finance by striving to avoid or mitigate negative environmental and social effects which contribute towards diversification of theeconomy by obtaining green economic growth.	The banking principles and sector guidelines were effectivelyplaced on January 1, 2015, and based on eight principles for protecting: natural environment, people & communities, cultural heritage, green economic growth, financial inclusion,ethical finance & corporate governance, transparency & accountability and reporting.
Nepal	2012	Nepal Rastra Bank set up an association to support the development of environmental and social risk managementby banks/DFIs to provide green lending.	Banks/DFIs did not put efforts to promote green finance. Regulators are required to follow strict measures for the adherence of procedures set under green banking policies.
Nigeria	2012	The guidelines relating to sustainable banking were followedwhich include nine parameters covering the implementation of	In March 2018, FMDQ OTC Securities Exchange, ClimateBonds Initiatives (CBI), and Financial Sector Deepening

		significant and transparent ESG practices. On annual basis, banks/DFIs identify the percentage of their portfolio assessed which shows the outcomes for the borrower and thebank.	Africa formed a partnership to strengthen financial stability and support overall economic growth and also issued Nigerian green bonds for a period of three years. This initiative may help to promote green banking in Nigeria.
Pakistan	2017	The SBP introduced green banking guidelines to promotegreen finance in the country.	Banks/DFIs are in process of formulating green bankingpolicies to be implemented for promoting sustainable banking.
Peru	2015	Banking, Insurance and Private Pension Fund Administratorslaunched the regulation for social and environmental risk management. Also, strengthen the role of due diligence in the regulation of socio-environmental risk management for financial firms.	Banking groups are developing these terms and conditionsinto banking policies so as to evaluate the borrowers.
Vietnam	2015	Formulated an action plan for the banking sector to apply theNational Strategy on green growth by 2020. The State Bank of Vietnam has set many priorities to promote green finance.	Banks are exploring green finance opportunities at differentlevels. However, the State Bank has issued directives to formulate ESG measures to evaluate borrowers.

While studying the case of Bangladesh, it is discovered that the Green Finance policy and strategy framework were designed and implemented in three stages. First, banks/DFIs must develop their green policies, which include policy development and governance, the introduction of environmental threats to prevent risk of default, the establishment of a climate risk fund, personnel training, consumer awareness, and the disclosure of green finance operations. Second, banks and DFIs widen their vision, which includes the development of sector-oriented environmental strategies, green strategy planning, an ecological risk management agenda from the viewpoint of financial firms, and extensive training to instruct customers and corporate houses. Third, banks/DFIs develop and market new products, as well as report on green banking practises and eco-friendly corporate social responsibility. In 2012, the Nigerian Sustainable Banking Principles went into effect. According to a press release from the Central Bank of Nigeria, "the implementation of the policies is to convey significant improvement which influences to the society while guarding the societies and environment in which financial firms and lenders work." These principles include governance, capacity building, collaborative partnership, environmental and social (E&S) risk management, E&S footprint, human rights, investment, and reporting.

The Central Bank of Brazil announced resolutions on financial firms' social and environmental responsibilities on April 25, 2014, along with instructions for implementing such policies. The National Development Bank invests significantly in green industries. According to its resolutions, banks must participate in E&S stress testing and take E&S risk into account when determining how much capital they required. As a result, banks are putting the central bank's recommendations for socio-environmental responsibility into practise. There isn't much proof that these programmes are influencing green financing, though.

In order to integrate E&S concerns into loan choices and product design, Mongolia adopted green finance guidelines and sector standards in 2014. In order to create green banking policies that would pave the way for attaining green growth and

sustainable development, the Federation of Egyptian Banks established a sustainable development committee in 2014. They are now developing green banking standards, and it is possible that borrowers will be judged accordingly. This initiative will support the growth of green banking throughout the nation.

In 2015, the State Bank of Vietnam created an action plan for promoting green banking and established certain priority areas. In order to comply with this, banks are researching the potential of green financing on various levels; nevertheless, the State Bank is cautious about implementing ESG standards so that banks may be able to assess borrowers in accordance with new processes. In 2016, through the wide-ranging survey from 32 banks and 329 respondents and utilising an exploratory factor analysis and regressions, researchers found that the awareness of green banking, recent efforts of green banking, and the priority fields have positively impacted the eagerness of Vietnamese banks to pursue banking polices; however, the challenges have been negatively related with the tendency to implement green banking services Pakistan was among others the last to introduce its green financing practises in 2017. Recently, Banks and DFIs are advancing their strategy structure so that all the terms and conditions established by the SBP can be covered. Though the procedure of green banking is sluggish but it can participate in overcoming environmental problems in the country.

To summerize, the evaluation of green economic strategies proposes that China and India have progressed in developing and implementing measures in thisrespect. Though other countries that are evaluated in this study are faraway with respect to their progress and execution of green finance polices as they may have to struggle in adopting these practices such as incapability of banks to evaluate the lenders in eco-friendly circumstances, banking personnel are not skilled and competent, absence of answerability, debtors are uninformed about implementing essential procedures to accomplish ecological measures, etc. These problems might show that extensive exertions are essential for both banks and debtorsto comprehend the reimbursements of green economics so it can be employed in its right essence.

Conclusion

Rapid industrialization, since the turn of the 20th century has led to a number of environmental and climate problems worldwide. The environment of developing countries would suffer as a result of GHG emissions if proper policies and procedures are not established. In order to address these issues, the idea of "green finance" was proposed in 2009. Under this plan, banks must assess borrowers based on the implemented environmental measures.

The goal of this study has been the assessment of Pakistan's green finance system for sustainable development. The SBP proposed green Finance Guidelines in 2017, with a primary focus on a risk management approach that assesses environmental risks that may result from business operations. The aim of green finance is to make sure that banks and DFIs adhere to an environmental risk management system that could help to reduce environmental risks. This procedure broadly includes identification of risk factors and assessing any potential negative impacts that are linked these risks. This study examined the demand and supply sides of green finance in Pakistan and brought to light a number of possible problems that the banks and borrowers may encounter. Additionally, it investigated the green finance

policies of developing nations and concluded that China and India have the necessary resources and know-how to put into practice green policies that aid in resolving environmental problems. Furthermore, it has been discovered that other emerging nations in the sample are making the required preparations to meet the demands of green policies. Banks and DFIs in Pakistan are developing Green Finance regulations so that debtors can be evaluated using this new approach. Banks and regulators must, nevertheless, support the entire process' implementation. Additionally, there is a significant potential for implementing green finance because it may aid in resolving environmental issues, while also improving enterprises' competitiveness in terms of lowering energy emissions

However, the SBP must take important actions for this to succeed: In order to ensure that businesses follow business procedures, the SBP should first create a system for monitoring the procedure over the course of funding. Second, the banking staff lacks the expertise to organize transactions involving green finance. Therefore, it is crucial that staff members be involved and receive the necessary training in order to fully comprehend and put Green Finance policies into practice. Third, the objective of green technology should be provided to stakeholders with clear explanation so that they can alter their business approaches as well as their needs. Fourth, the SBP needs to make clear the compliance criteria that must be achieved in order to decide whether or not Green Finance strategies can be completely or partially implemented. Fifth, there is no mention of the method for introducing novel financial products, such as green IPOs, green bonds, green funds, etc. Lastly, it is crucial to make an effort to raise awareness of the idea of green finance among various stakeholders, not just those in the banking and regulatory sectors. The promotion and growth of green business in Pakistan will be assisted if the recommendations provided in the study are taken into account. From a social point of view, Green Finance will encourage a green atmosphere across the country. Additionally, it is necessary to conduct comprehensive empirical assessments to identify how Green Finance affects the environmental issues all over the country.

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RETHINKING WATER AND SCALING UP SOLUTIONS FOR SUSTAINABLE DEVELOPMENT IN THE WATER SECTOR

By:

Ms. Fatima Eman[1]

ABSTRACT

Water scarcity has become a major challenge for Pakistan whose economic growth and regional trade expansion depend upon agriculture. Rapid urbanization, poor management, and outdated infrastructure have impacted the water sector of Pakistan. Undoubtedly, Pakistan lies in the region where necessary natural resources exist in abundance, but its irrigation system is poorly managed. Harnessing such potential challenges requires an integrated approach that would ensure environmental sustainability to meet Sustainable Development Goal 6. Several projects have been carried out and proposed by WASA, Lahore for scaling up solutions to achieve sustainable development of water resources. However, a well-defined action plan along with financial support is needed to boost water supply, rationalize consumption, and improve efficiency. Moreover, there is a need to implement price-based reforms in water tariffs and understand water rights to minimize inefficient usage of water resources.

1. INTRODUCTION

Pakistan is facing serious issues related to water scarcity due to rapid population sprawl, poor water sector management, and inefficient infrastructure followed by climate change. Lahore's water supply is entirely based on groundwater extraction through tube wells. The water distribution system of 5826 km length is fed by 596 tube wells, managed by WASA Lahore. These tube wells yield approx. 1000 cusec water, and its quality lies within National Standards for Drinking Water Quality (NSDWQ). The number of tubewells is progressively growing, and the need for water supply has increased, especially in the previous two decades due to rapid population growth, urbanization, and industrialization. A sizable amount of the land has become impermeable resulting in a reduction of groundwater recharge. With the lowering of the water table, the quality of water is also deteriorating, and the concentration of TDS (total dissolved solids) is increasing with the increase in depth of tubewell. Yet, this condition may be managed, and the decline of the water table can be stopped with improved planning and administration.

1.1 Urban Sprawl

Pakistan has the highest rate of urbanization among South Asian countries. According to the 2017 Population Census, 36.44% of the population lives in urban areas while the figure found to be 32.50% in 1998, clearly indicates the urban sprawl in Pakistan [1]. Moreover, the annual average growth rate of 2.4% is determined by the overall population of the country [2]. Fig. 1 represents the water availability to the population residing in Pakistan. It shows how the population will grow with each

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passing year if the relevant measures are not taken into consideration. It also indicates that per capita annual water availability has dropped from 5,600 m^3 to the current level of 908 m^3. This decrement will continue to proceed under the current population growth rate.

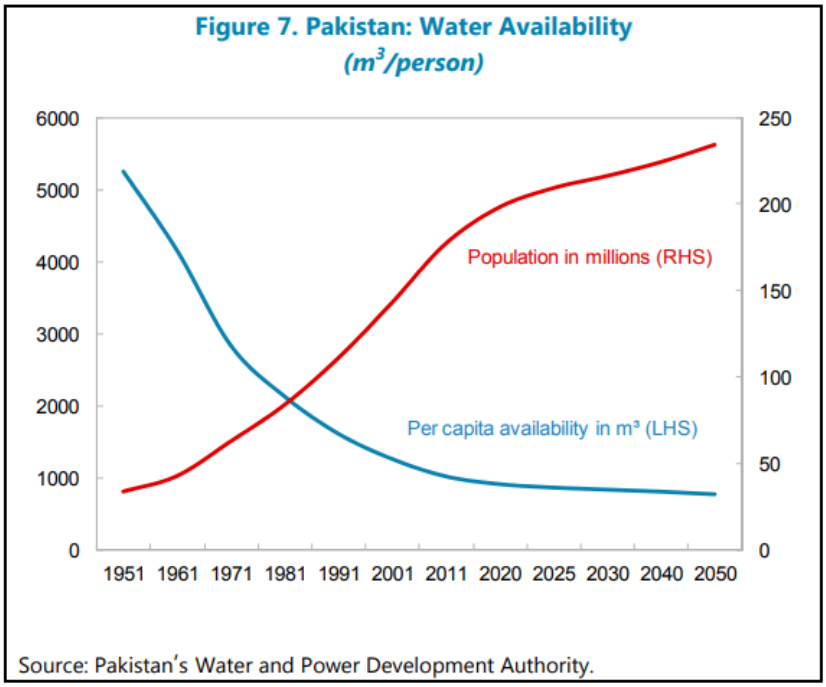

Figure-1: Per capita annual water availability projection

1.2 Water Scarce Country

Pakistan has the highest rate of water usage and falls at 4th number in the world. Comparing the amount of water used with the Gross Domestic Product (GDP) depicts that no other country's economy is as water intensive as that of Pakistan. The IMF report 2021 indicated annual water availability as 1017 m^3 in Pakistan, which is close to the scarcity levels of 1000 m^3 [3]. Pakistan has been ranked 14th among seventeen (17) extremely high-water risk countries of the world. United Nations Development Programme (UNDP) and Pakistan Council of Research in Water Resources (PCRWR) warned that the country would reach absolute water scarcity by 2025.

1.3 Impact of Climatic Change

The sole source of water supply in Pakistan is Indus system and its tributaries, but water availability in Indus River is seasonal. Snow and glacier melting provide 85% of the annual river flows from June to September in the country which coincided with the rainfall occurring in Monsoon. According to the World Bank, Pakistan is one of the world's most arid countries with an average rainfall of under 240 mm a year. Being dependant on glacial & snow melt and precipitation, the Indus River Basin is highly sensitive to climate change. The variations in monsoon patterns, increasing temperature and recurrence of flood & droughts adversely affect the water resources [4]. The country recently experienced floods in 2022 which caused an economic loss of about 15.2 billion USD, 1730 deaths, and affected 33 million people [5]. Similarly,

Quetta and Balochistan witnessed droughts for a span of eight (08) years from 1997 to 2005. Such an alarming situation indicates that climate change may decline aggregate water flows in the future. Changes in temperature and precipitation patterns would also impact rainfall recharge to groundwater resources.

2. EXISTING GROUNDWATER CONDITION OF LAHORE

Lahore, like many other cities in Pakistan, heavily relies on groundwater for its domestic, industrial, and agricultural needs. Over-extraction of groundwater for these purposes, coupled with poor management practices, has led to a decline in the water table and an increase in the concentration of pollutants in the groundwater. From the past two decades the average rate of decline of water table in Lahore is about 1 meter (3.28 ft) per year. Currently, the average static water level ranges from 120 ft to 130 ft. The existing situation of ground water elevation in meters is presented in different areas of Lahore (Fig. 2).

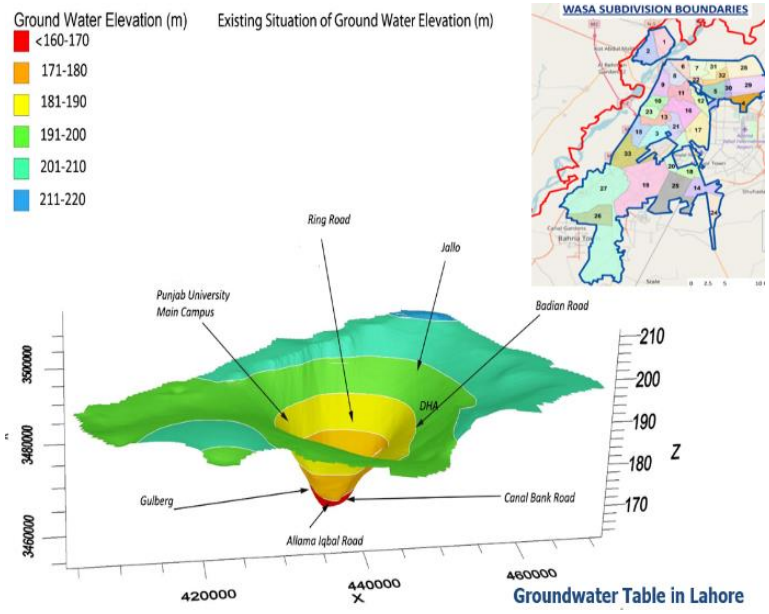

Figure-2: Ground Water elevation in Lahore

From Figure-2. It can be observed that excessive pumping has resulted in lower groundwater elevation from mean sea level (AMSL) in Gulberg and Alama Iqbal Road causing the formation of cone of depression.

Table-1: Average Annual Withdrawal of Water and Consumption Volume in Pakistan

Sources	Water Withdrawal (Billion m^3)	Consumers	Water Consumption (Billion m^3)
Canals	122	Irrigation	80
Ground water	62	Livestock	1
Total	184	Municipal	1
Double Counting	48	Industrial	<1
Net withdrawal	136	Total	82

Table-1 shows that the water abstraction is reached to 136 billion m^3, while consumption is only 82 billion m^3. This excessive extraction of 54 billion m^3 results in water wastage. It is also reported that only two-thirds of available water is being utilised while one-third of the water is either lost or discharged into the sea. If the current situation is not controlled, the water level will decline to the level that it cannot be used for drinking purposes due to added contamination.

3. WATER CONSERVATION PROJECTS AND MEASURES TAKEN BY WASA, LAHORE FOR SUSTAINABLE DEVELOPMENT

The Water and Sanitation Agency (WASA) Lahore has undertaken several projects for water conservation and sustainable development of water resources. Some of the notable projects and measures are:

- **Rainwater Storage System:** WASA Lahore has developed three rainwater storage tanks at the location of Lawrence Road, Sheranwala gate, and Kashmir Road in Lahore with storage capacity of 1.5 million gallons each, to not only address the chronic urban flooding at these points but also to reuse the collected rainwater for other purposes such as horticulture etc. WASA Lahore is also accessing the option of groundwater recharge from these tanks after assuring the quality aspects of stored water.
- **Water Supply Improvement Projects:** WASA Lahore has undertaken several projects to improve the water supply system in the city. These projects include the installation of new water treatment plants, rehabilitation of existing plants, gradual Installation of water meters on PPP mode and new water pipelines. Implementation of Pilot Project of establishment of District Metered Area (DMA) in Lahore for reduction in Non-Revenue Water (NRW) is underway. These efforts will help to increase the availability of clean water in the city and will ensure the sustainability of water resources.
- **Water Conservation Campaigns:** Several public awareness campaigns have been launched to promote water conservation practices. These campaigns include public service announcements, billboards, and social media campaigns. The aim of these campaigns is to encourage citizens to conserve water by fixing leaks, using water-efficient appliances, and reducing water wastage.
- **Wastewater Treatment Plants:** Construction of six wastewater treatment plants in the jurisdiction of WASA Lahore has been proposed to treat and recycle wastewater. The treated water can be used for non-potable purposes such as irrigation and industrial use. This initiative will help to conserve freshwater resources and reduce pollution in water bodies such as River Ravi and underlying groundwater aquifer of Lahore.
- **Surface Water Treatment Plant**: To reduce the reliance on groundwater resources, a surface water treatment plant (100 cusec) at the BRBD canal has been proposed to supply drinking water to Lahore.
- **Intermittent water supply**: The operational hours of the tube wells has been reduced from 18 hours per day to 10 hours per day to reduce the stress on

aquifer. This practice has also reduced the expenditure of electricity and wear and tear of machinery etc.

- **Enforcement of regulatory regime on groundwater abstraction:** No department/agency will be allowed to install tube wells without prior permission and aquifer charges will also be imposed depending upon the capacity of tube well/volume of the extracted water, under the Punjab Water Act 2019.
- **Reduction of stress on deep groundwater resources:** The water supply connections of the service stations have been disconnected with the directions to install ejector pump in the shallow aquifer to reduce the stress on deep aquifer.
- **Water Recycling at Car Washing Stations:** Recycling plants had been installed at 310 washing stations in Lahore to save 350,000 gallons/day of water. The Directions was conveyed to District Administrators and Local Govt. Department for replication.

These projects and measures are crucial in promoting sustainable water resources and water conservation in the city. However, more needs to be done to ensure the availability of clean and sufficient water resources for the growing population of Lahore.

4. WAY FORWARD

There is a dire need of reforms that should be adopted to accelerate the change, to achieve the sustainability and scaling up solutions for sustainable development in the water sector.

- **Integrated Water Resources Management**

  There is a need to develop an integrated approach that must consider sustainability of water resources at priority. Development of such an approach towards water resource management will be beneficial in water conservation, infrastructure upgradation and revenue generation.

- **National Action Plan**

  A well-defined National Action Plan should be introduced in the country to conserve water resources in near future. The objectives of the National action plan should incorporate emerging water crisis, based on which development of overall policy framework and master planning should be carried out.

- **Infrastructure Improvement**

  Infrastructure improvement is a dire need of the hour to solve the water-related issues. In this regard, WASA Lahore has taken step to rehabilitate existing Ravi Syphon, and construction of Intake Structure, Gates, and Raw Water Channel. This project will lead to improved efficiency of the water supply system by creating self-sustaining Water Distribution Zones. Moreover, community will be provided with 24/7 supply of adequate quantity of safe drinking water in target areas.

- **Water Tariff & Metering System**

  To conserve water and assure its quality, it is considerate to revise the water tariff and introduce metering system. To proceed with this, WASA Lahore has decided to install 711,625 water meters on existing connections (93% Domestic and 7% Commercial). This project will result in water saving of about 108 MGD and reduction of Non-Revenue Water (NRW).

- **Wastewater Treatment recycling**

  Treatment of wastewater can create an impact to mitigate water crisis and reduce pollution of water bodies.

- **Community Participation**

  Community can be considered to overcome water deficiency. Public should be aware of the National Water Policy 2018 to realize the fact that water is a finite source. They are expected to use the water effectively and play a role in-time water bill payment.

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SMART TECHNOLOGICAL SOLUTIONS FOR SUSTAINABLE DEVELOPMENT

By:

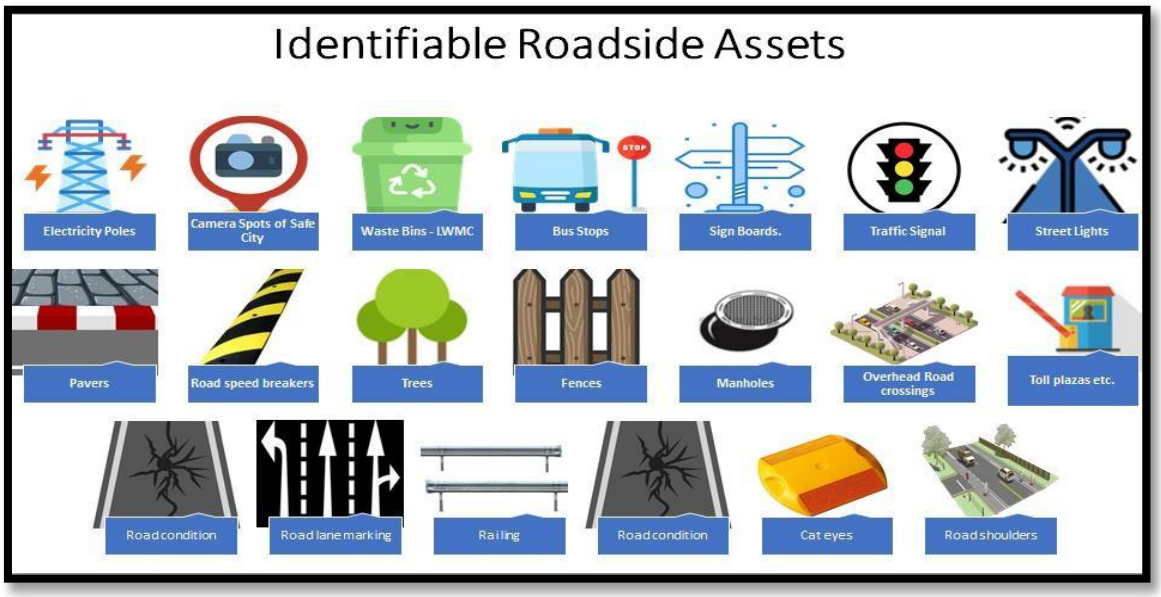
Dr. Abdul Basit

1. AUTOMATED DETECTION OF ROADSIDE ASSETS USING AI

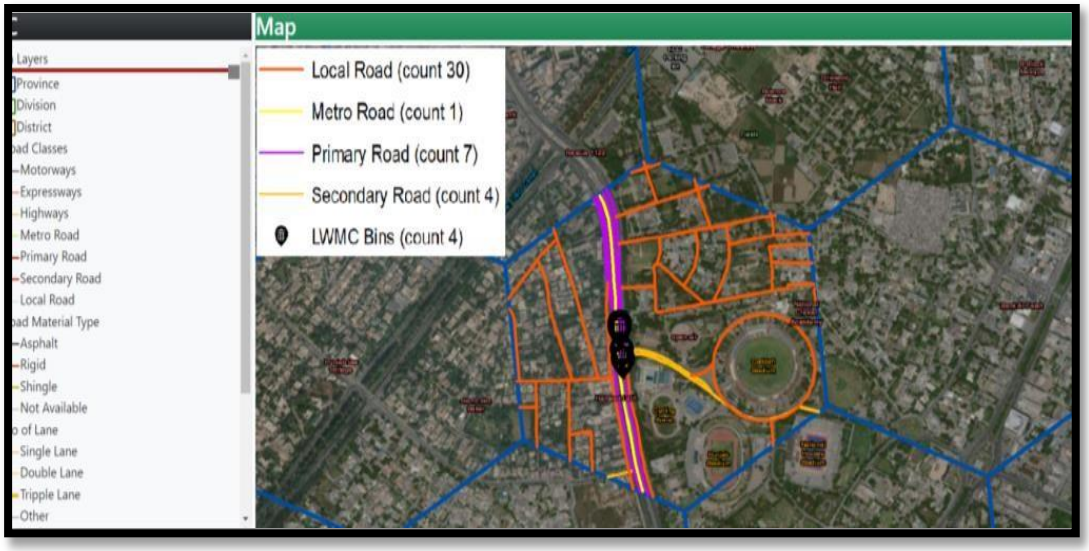
1.1 Summary

The Urban Unit has collaborated with the C&W Department of the Punjab Government to work on Roadside Asset Detection Project. (Manual Surveys to digitize such assets are highly expensive and require a lot of human effort. Despite all these, data quality remains a question because of human error. This project aimed to utilize cutting edge technologies to accomplish such tasks in low cost without compromising on data authenticity. A deep learning algorithm was trained for the detection, classification, and localization of traffic signs from roadway imagery. To conclude, this research study aimed at the following key objectives: Data Collection of the roadway assets on top of which the deep neural network can be well trained.

The Deep Convolutional Neural Network (CNN) will be repeatable among multiple runs and reproducible across different locations in Pakistan. Lastly, a real-time automatic detection solution will be provided which will reduce the time between the data collection and the delivery, hence enhancing the data-driven decision-making process for maintaining inventory wear and tear.



A live dashboard has been built online displaying all the roadside assets on a particular road. The dashboard facilitates the users to download reports and display all the roadside assets that can be used for further road rehabilitation in the long term.


Map
Layers
Province
Division
District
ad Classes
Motorways
Expressways
Highways
Metro Road
Primary Road
Secondary Road
Local Road
ad Material Type
Asphalt
Rigid
Shingle
Not Available
of Lane
Single Lane
Double Lane
Tripple Lane
Other
Local Road (count 30)
Metro Road (count 1)
Primary Road (count 7)
Secondary Road (count 4)
LWMC Bins (count 4)

1.2 Results


61 traffic light 0.69
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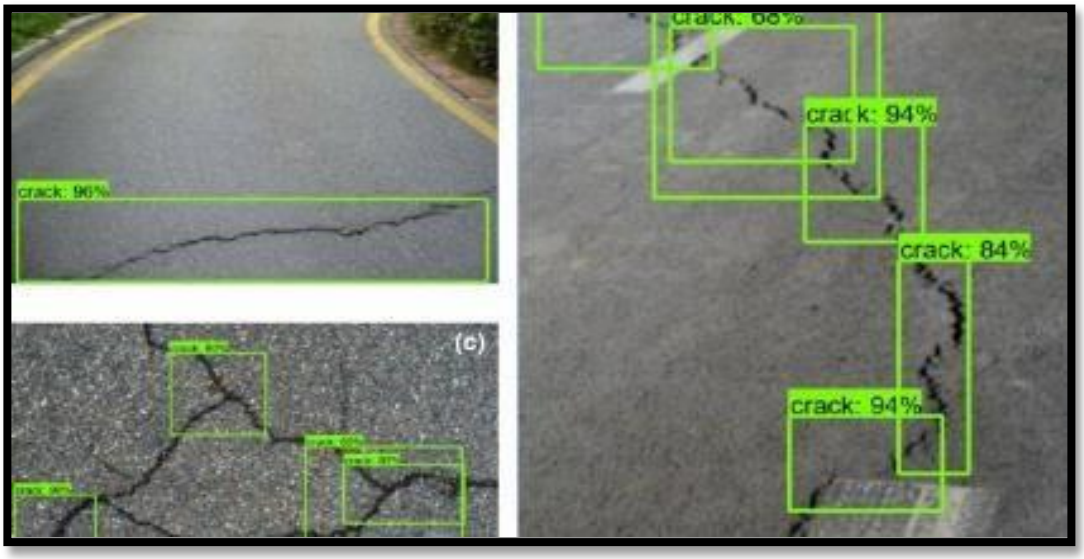
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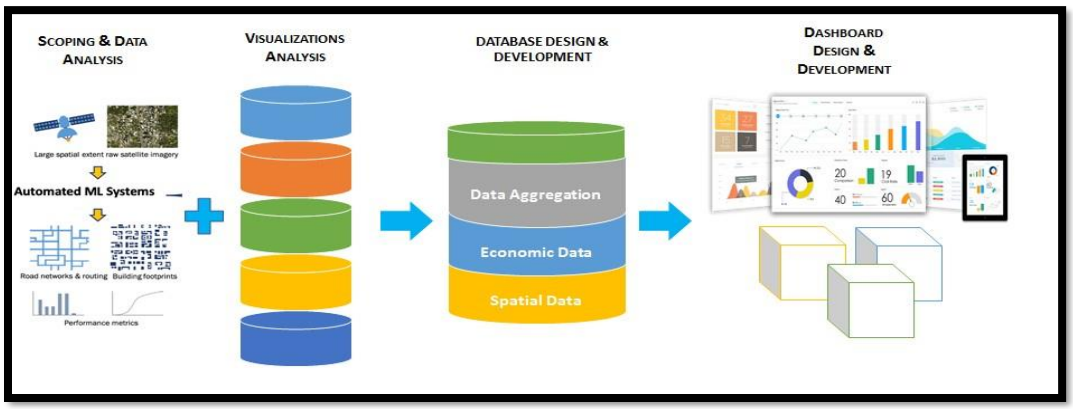
2. AUTOMATED DATA EXTRACTION FROM SATELLITE IMAGE

2.1 Summary

Urbanization has led to a significant increase in the population living in urban areas and this trend is continuing to grow. With this growth, government departments are dealing with an exponential increasein the volume of data, as people in urban regions generate more data through various activities. This rapid growth in velocity, verity and volume of data requires urgent measures to manage and use this data to generate value for better quality of life. The ICT development team has developed a vast dataset of different assets (Solar Panels, Parks, Parking lots, etc.) for an automated detection of these assets using Machine Learning systems for improved decision making and e-governance in Punjab.

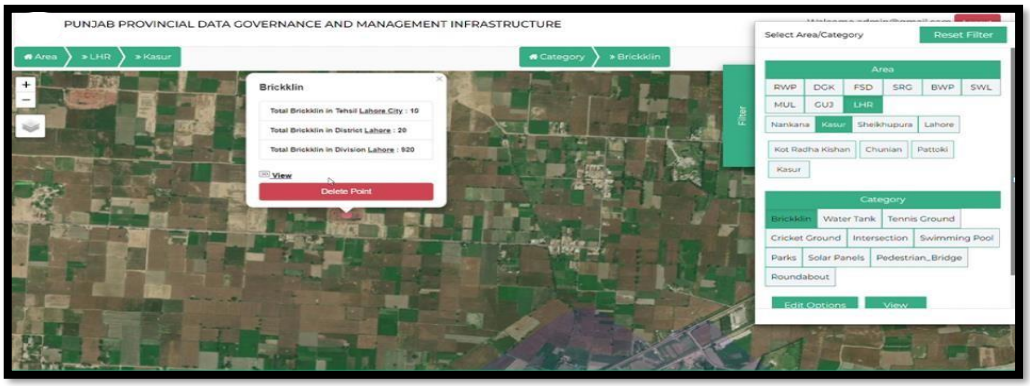
Sticking with only ancient GIS techniques to digitize satellite data in present era is not a wise approach; the world has already shifted on AI based techniques to perform such tasks. ICT team had showcased such possibilities with limited resources and challenges. No manual survey is needed to digitize assets.

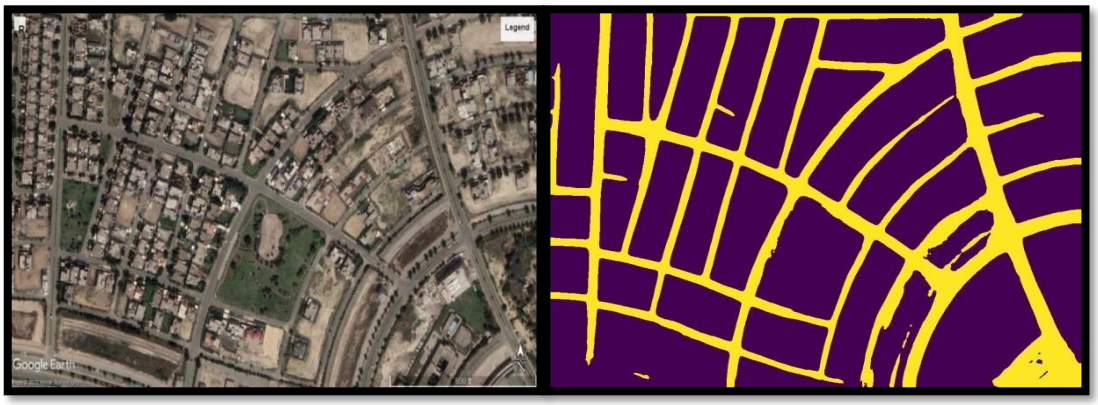
The whole work flow can be illustrated using the below image:



Machine learning systems were used to generate a mask image of a road network by utilizing a segmentation model. The model was trained to recognize the boundaries in the input images, identify the road network, and generate a mask image where only the roads are visible and the rest of the image is zeroed out. Input images could be satellite or aerial photographs, or street-level imagery with the perspective view that is collected from a fixed geographic location.

2.2 Results



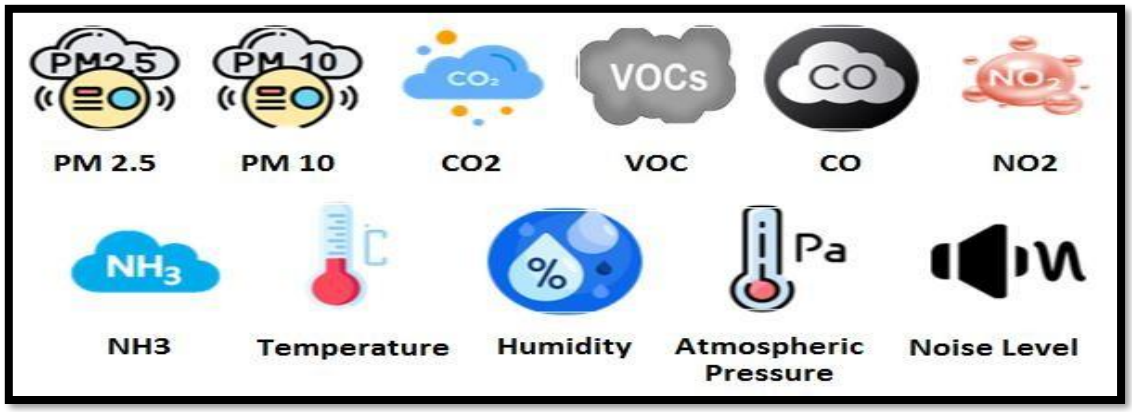


3. ROBOTICS LAB

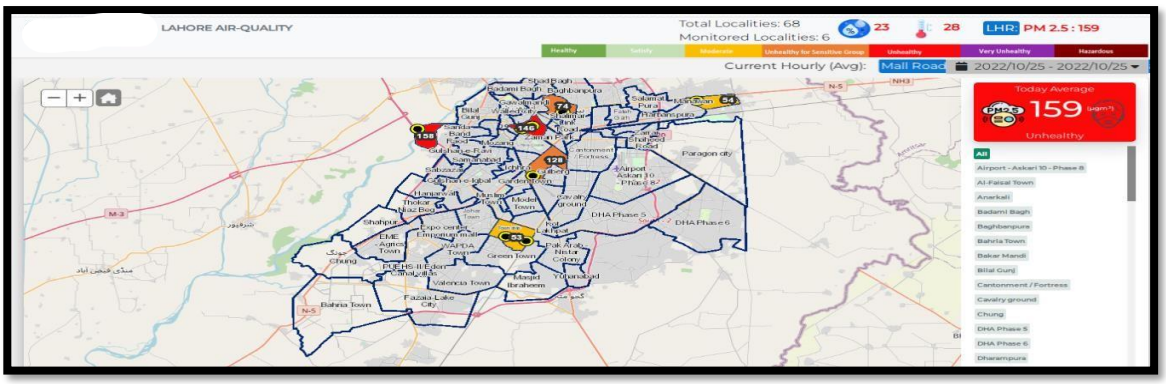
3.1 LOW-COST AIR QUALITY SENSOR

Robotics Lab working under the banner of The Urban Unit (A subsidiary Company working under the Punjab Government) has developed a low-cost IoT-based sensing system that identifies the amount and level of harmful gases and particulate matter in the air. The good vital points of the system are cost- efficiency, portable, ease of usage, and real time (fast) processing. Moreover, efficient ML algorithms have been used for calibrating the results to make them more precise.

A dashboard was developed to showcase the real time data from multiple remote locations. It is presumed that the system will overcome many challenges and replace many of the previous AQM sensing modules. The sensor has the capability to detect 11 different parameters:

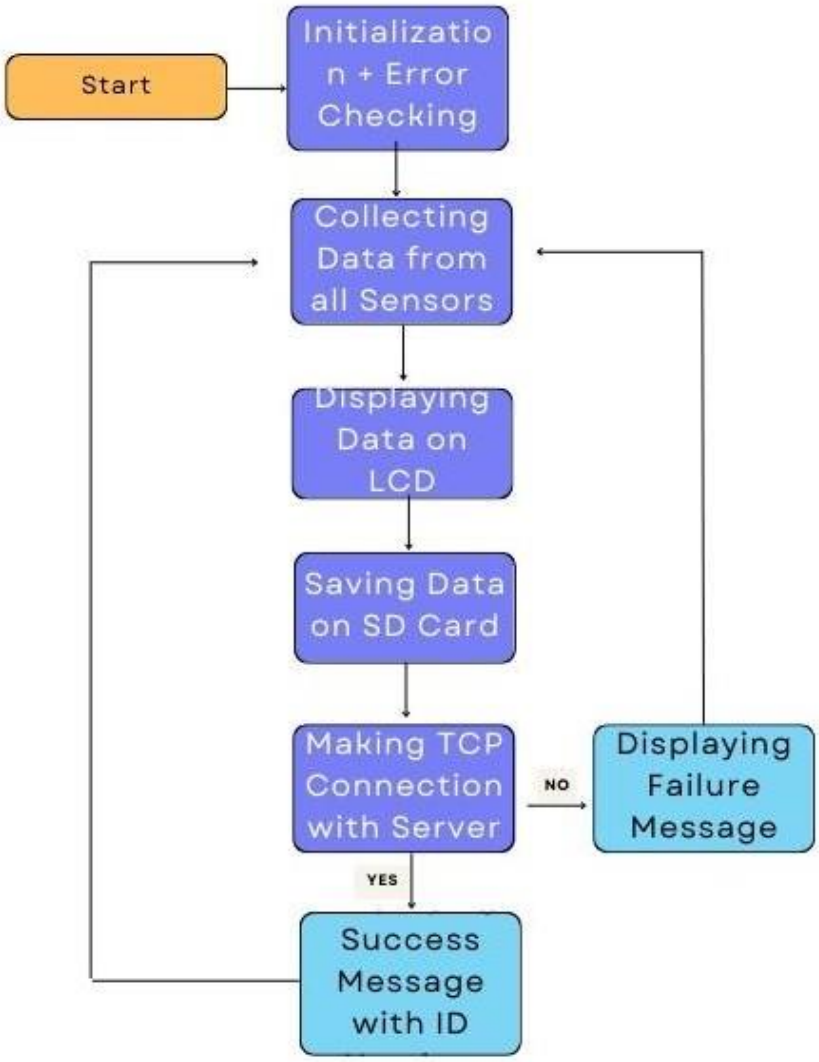


The ICT team has achieved remarkable results in this study and collaborated with Environment Protection Agency (EPA) Punjab to deploy these sensors nodes on multiple locations in Lahore. These sensors can send real time data from remote location to control room using GSM (Global System for mobile communication). Developed countries are also opting the same technique to identify hot areas in cities as it is not possible to install highly expensive equipment in each part of the city.



Flowchart

A flow chart representating the working of the system is shown below:

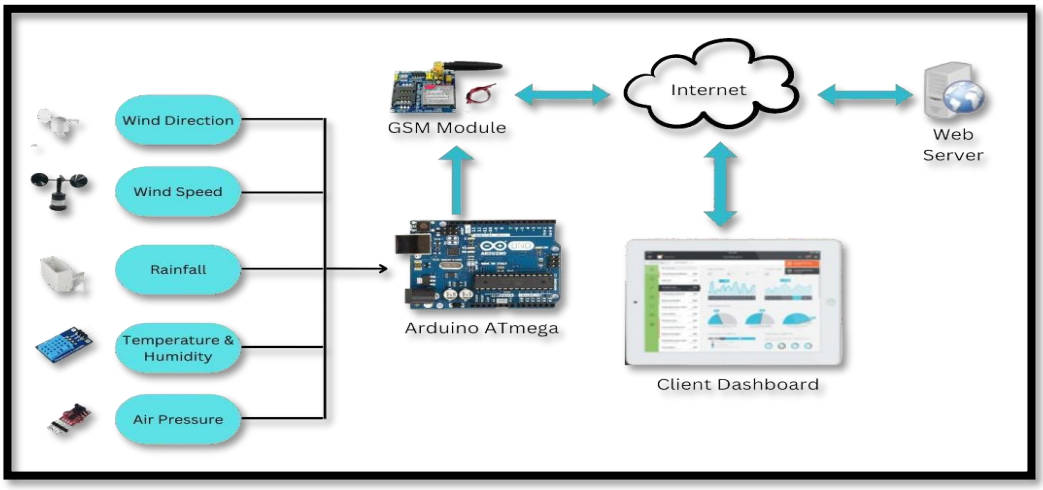


Conclusion:

The Urban Unit's ICT research has concluded that deploying a network of low-cost air quality sensors could be an effective method of minimizing smog in urban areas. However, the successful implementation of this system does require regular maintenance and calibration.

3.2 IoT-BASED WEATHER MONITORING SYSTEM

Torrential monsoon rains triggered the most severe flooding in Pakistan's recent history, washing away villages and leaving around 3.4 million children in need of assistance and at increased risk of waterborne diseases, drowning, and malnutrition. Weather Monitoring System using IoT can be used to detect, record, and display various weather parameters such as temperature and humidity. The idea of the internet of things is to connect a device to the internet and to other required connected devices. Using the Internet the information from the IoT device can easily be transferred to the cloud and then from the cloud to the end user. Weather Monitoring is an essential practical implementation of the concept of Internet of Things; it involves sensing and recording various weather parameters and using them for alerts, sending notifications, adjusting appliances accordingly, and also for long-term analysis.

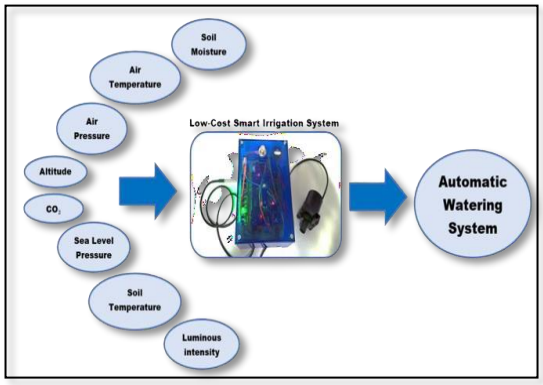


3.3 SMART IRRIGATION SYSTEM

The Government of Punjab proposes urban forestry to improve the air quality and reduce extreme weather situations by planting trees, storing carbon, and reducing urban energy consumption. For this, an automatic irrigation system is required that can irrigate the plant when the soil gets dry and needs water. The Robotics Lab of the Urban Unit has developed an irrigation system designed for automatic water supply to urban forestry plants and trees to hydrate in severe weather conditions. The general idea taken into account to proceed with an irrigation system is that a microcontroller will be installed for the intelligent controlling of the watering of plants. After the plantation of the plant in the field, the microcontroller-based system should provide water daily during 1-2 weeks, then 2-3 days during 3-12 weeks, and then weekly for 12-some weeks till the plant establish its roots. As plants need particular soil, water, light, and atmosphere care at the start (during the growth process), thus the designed system makes sure that the plant effectively gets all its basic needs,

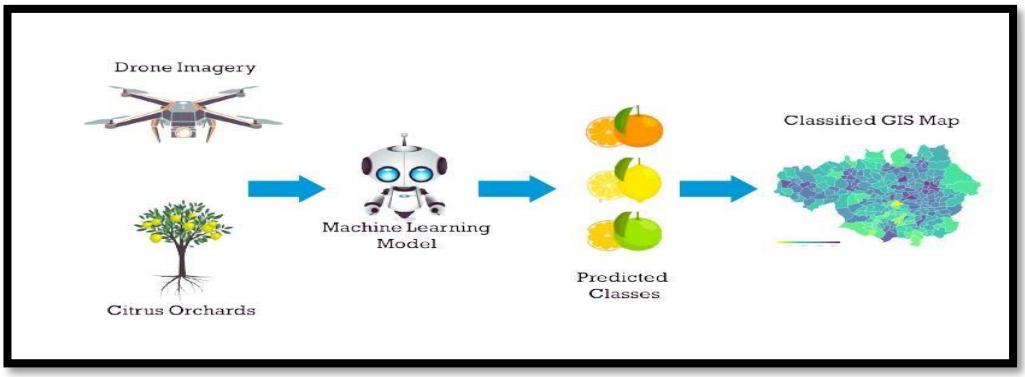
especially during its growth. This system is a step toward the target of Ten Billion Tree Tsunami Programme, which is the government's vision towards Clean and Green Pakistan.

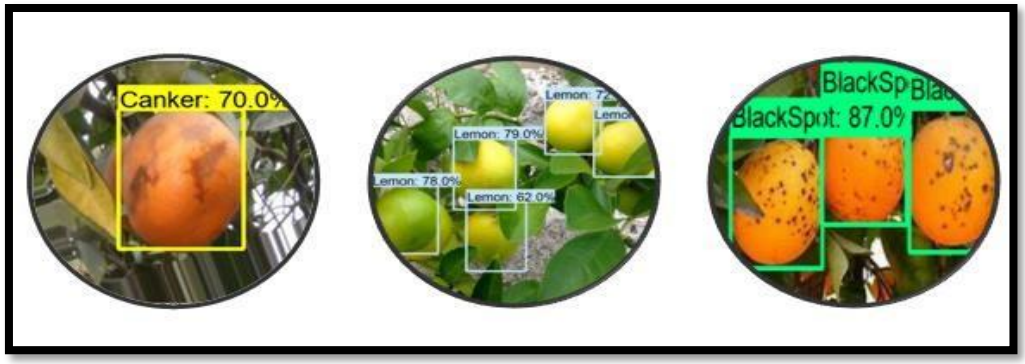




3.4 CITRUS DISEASE DETECTION

A big share of export quality citrus fruit is rejected annually due to the presence of citrus-related diseases on fruits. There is an urgent need to control the disease to a reasonable level and be able to sort various types of Citrus. It is also very important to differentiate between sick and disease free fruit. With the help of Deep Machine Learning Algorithms, Image Analysis, and Advance Artificial Intelligence, it is now possible to identify the diseases in the fruit and sort them according to various quality grades. The Robotics Lab of the Urban Unit has developed an automated citrus types and diseases detector that is capable of identifying citrus diseases on images and video streams. The Urban Unit collected data from various citrus orchards in Sargodha, Khushab, Mandi Bahauddin, Chiniot, Rawalpindi, and Layyah.



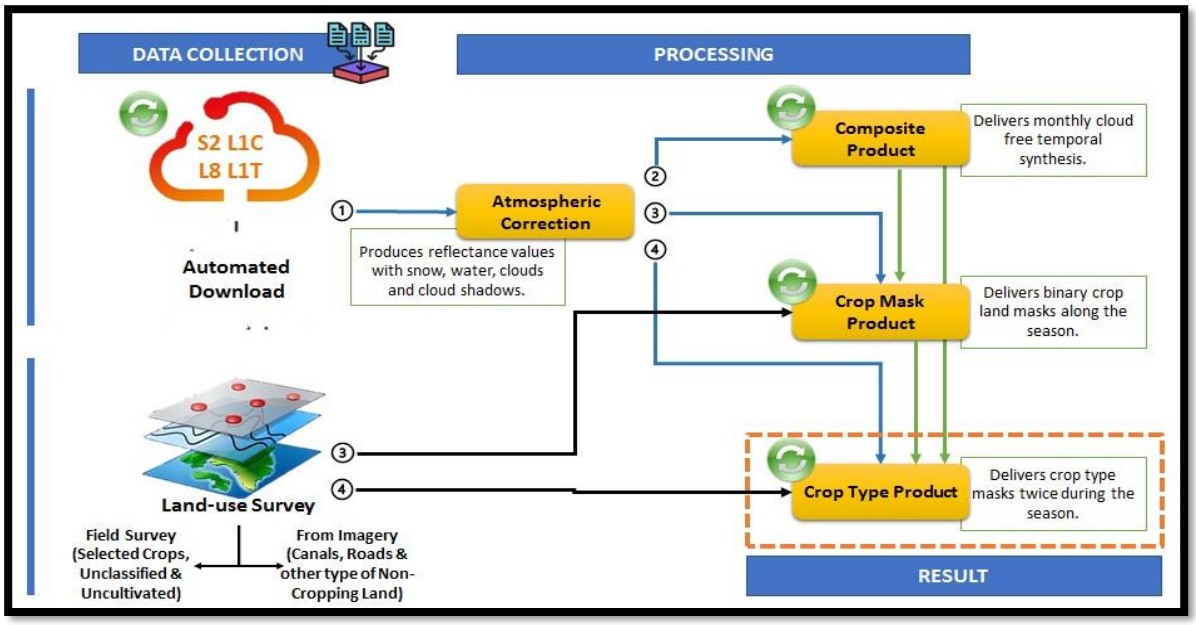


4. 3D DIGITAL TWINS – FOR URBAN CHALLENGES

Quality of Satellite Image vs Our Imaging Solution

- Our solution
  - 3CM Image Resolution.
  - 3D Modeling of the AOI.
  - Detailed Digital Elevation Model.
  - Orth rectified Image.
  - Ready for the consumption for ML algorithms.
  - Image re-acquisition as and when needed.
  - Customized image capturing angle other than nadir.
  - Capacity build within the department
  - Same apparatus can be used for other surveys
- Satellite Image
  - Min 30CM image resolution.
  - Only 2D image.
  - In accurate digital elevation estimation.
  - Extra charges for ortho-rectification of imagery.
  - Cost effective image re-acquisition.
  - Limited image capturing angles.
  - Have to purchase new image for every project.

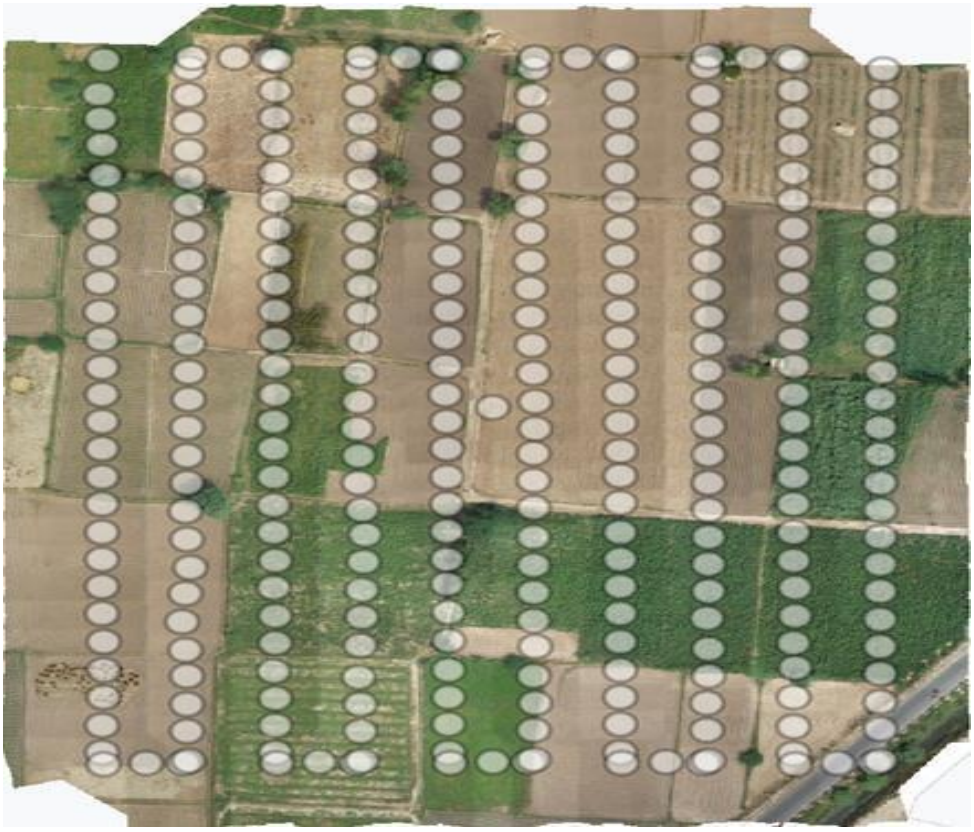
5. MACHINE LEARNING FOR MAKING SENSE OF EVERYTHING



5.1 DRONE IMAGERY ACQUISITION AND ANALYSIS

The ICT team acquired small DJI drones for survey of different areas for Crop identification and Image Segmentation techniques.

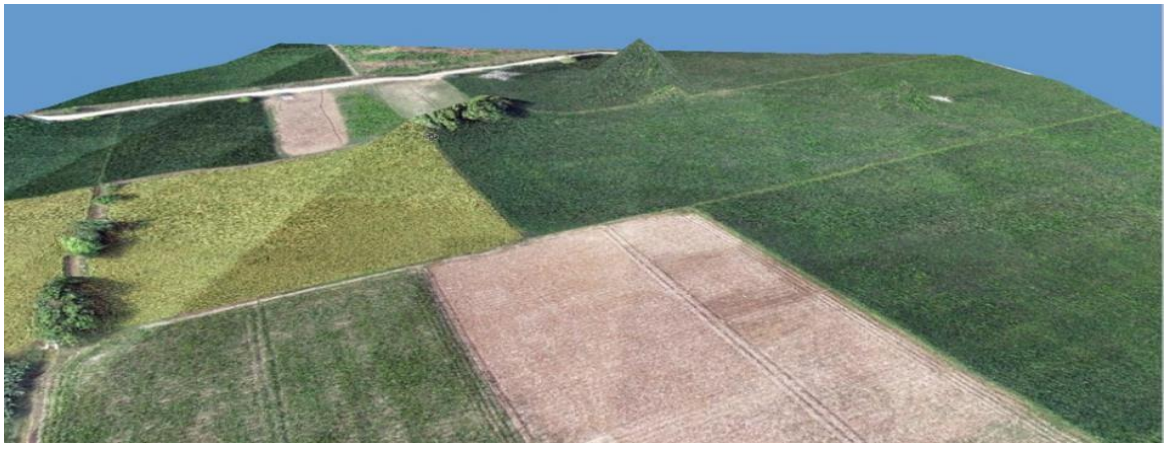
DJI Terra for Drone Image Mosaicking

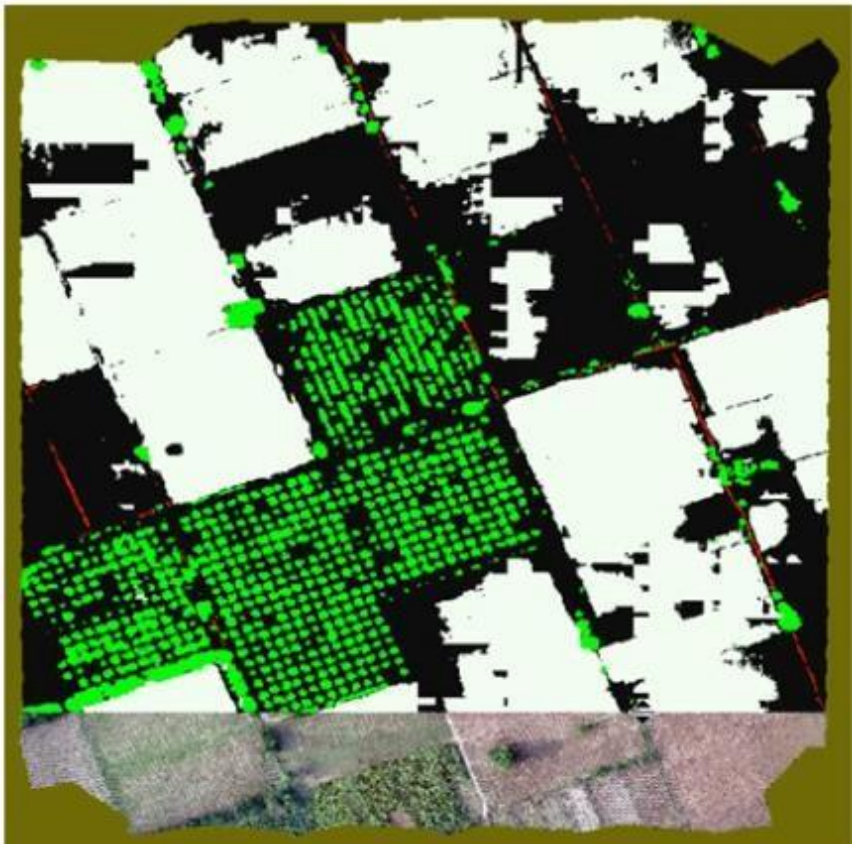


5.2 Drone Imagery Applications

Some further applications of Drone Imagery include:

- DEM Generation.
- Image Segmentation





SOME CONCEPTS

PEATLANDS AND MANAGEMENT / CONTEXT OF PAKISTAN

By:

Ms. Maryam Eqan – WWF (Pakistan)

Peat is created from plants growing in waterlogged conditions: when the plants die, they do not fully decompose and are partially preserved in water over centuries. Peatlands are a type of wetland found all over the world. But in Pakistan, they occur only in high-altitude Chitral and parts of Gilgit-Baltistan (Zahiruddin, 2022).

Apart from 3,000 plus acres of peatlands of Baroghil, peatlands are found in Sha Junali (1,300 hactares), Gobor and Karimabad (900 hactares each), Laspur (1,000 hactares) Golen (700 hactares), Terich Ann (400 hactares), Melp (300 hactares), Madak Lusht (320 hactares) and Chitral Gol (250 hactares). As per study of Pakistan Wetland Programme (PWP) conducted in Chitral in 2010, only in Baroghil area in north of the district, over 75 per cent of peatlands have undergone total depletion. (Zahiruddin, 2019)

A major reason for depletion of peatlands in all the localities is the tremendous pressure exerted by the local people who use them for fuel purposes as peats are highly combustible whose blocks are made and dried up in summer to be used throughout the year for cooking and heating purposes.

As per survey of PWP in Baroghil area, the use of peats is 200kg to 300kg per household during winter season which falls slightly during summer as it accounts for 75 per cent of fuel requirements. Unaware of the significance of peatlands, some of the government departments and the management of an NGO inflicted a big loss on the peatland of Baroghil last year by their ill-planning while constructing a road.

The drainage of peatlands to convert them into agricultural land is yet another reason of their depletion which is in practice in the valleys other than Baroghil. In Golen and some other valleys, peatland was converted into a farmland to grow potato as the soil was productive for the commodity.

Responsible peatland management means undertaking activities in a transparent and accountable manner, following ethical and humanitarian principles applied in ways that promote stewardship of the peatland resource that will be acceptable to future generations. (International Peatland Society, n.d.)

A peatland management plan is required that can undertake peatland management by safeguarding peatland's environmental, social, and economic functions and respecting their local, regional, and global values. It is important to ensure that high conservation value peatlands are identified and conserved, utilized peatlands are managed responsibly, drained, degraded or otherwise changed peatlands are rehabilitated to reinstate as many ecological and landscape functions and services as possible and provide those involved in or responsible for peatland management with strategic objectives and actions for implementation.

Grasslands

Grassland is an area in which the vegetation is subjugated by a nearly incessant cover of grasses. Grasslands occur in environments favorable to the development of this plant cover but not to that of taller plants, predominantly trees and shrubs. The aspects preventing establishment of such taller, woody vegetation are diverse (Devine, 2016).

There are two chief kinds of grasslands: tropical including hot savannas of sub-Saharan Africa and northern Australia and temperate including Eurasian steppes, North American prairies, and Argentine pampas. In Pakistan, grassland ecosystems are found in Gilgit, Kashmir, Waziristan, lower Chitral and North Kalat (Government of Pakistan, n.d.).

Bio-Char-from Crop residues and its application in Pakistan.

Biochar is a charcoal-like material that's made by burning organic material from agricultural and forestry wastes (also called biomass) in a controlled process called pyrolysis (Regeneration International, 2018). The biomass and raw material from which biochar is fashioned primarily come from a variation of materials. Agricultural biomass is well-thought-out as the most copious renewable resource. Key sources and feedstock of biochar include crop straw and residues, animal manures, fruit pits, twigs, and leaf litter forestry wastes as well as food leftover and bagasse (Shaaban, 2021).

Biochar is very helpful to reduce and remove CO2. Half of the emission reductions and the majority of CO2 removal result from the one to two orders of magnitude longer persistence of biochar than the biomass it is made from. Globally, biochar systems could deliver emission reductions of 3.4-6.3 PgCO2e, half of which constitutes CO2 removal (Lehmann, 2021).

In Pakistan, Biochar, a product of biomass pyrolysis, improves the nutrient and water holding capacity along with production of syngas for bioenergy. Biochar allows to recycle farm waste. Biochar addition at 0.5 % increased total organic carbon 23-30 % in soil. Biochar produced at 400 °C with low pH and high cation exchange capacity is a better option than other amendments as it resulted in the highest values of cation exchange capacity and deemed fit for alkaline soils of Pakistan using suitable feedstock, preferably bagasse. Biochar combinations of high nutritious value, e.g., municipal solid organic wastes and animal manures, may directly provide plant nutrients. In arid areas, studies showed improvement in plant growth and yield by biochar application.

Mangroves

Mangroves are a type of tropical and subtropical coastal vegetation found in the intertidal zones of coastlines. They are characterized by their ability to tolerate saltwater and the high levels of salinity in their surrounding environment. Mangroves play a crucial role in the ecosystem, providing habitats for a variety of plant and animal species, serving as nursery grounds for fish and other marine species, and protecting coastlines from the impacts of storms and sea level rise. They also play an important role in carbon sequestration, absorbing and storing large amounts of carbon dioxide from the atmosphere, making them an important tool in mitigating the effects of climate change.

In Pakistan, mangroves are found along the coastline of Sindh and Baluchistan. The mangrove located along the delta of the river Indus in Sindh is the largest mangrove forest in Pakistan. The 600,000 hectares of mangroves that are surrounding the Indus Delta are thought to be the world's biggest dry-climate mangroves (Graana Blog, 2022)

COP-26

COP26 is the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC). It was held in Glasgow, Scotland, in November 2021. The main objective of COP26 is to bring together representatives of the Parties to the UNFCCC, including governments, intergovernmental organizations, civil society, and the private sector, to negotiate and implement measures aimed at mitigating and adapting to the impacts of climate change. Glasgow climate pact came out as a historical document of COP26.

COP26 is considered a critical moment in the global effort to tackle climate change, as it is produced a significant increase in the level of ambition of countries' nationally determined contributions (NDCs) to reducing greenhouse gas emissions.

The event also focused on promoting the transition to clean energy and low carbon development and strengthening cooperation and solidarity among Parties in support of climate action. Additionally, it provided an opportunity for Parties to exchange views and experiences, share best practices, and build trust and confidence in the implementation of the Paris Agreement.

The outcome of COP26 have significant implications for the future of the planet, as it is expected to shape the international community's efforts to address the impacts of climate change, such as rising sea levels, more frequent and intense extreme weather events, and biodiversity loss.

In conclusion, COP26 was a critical moment in the global effort to tackle climate change and brought together a broad range of stakeholders to negotiate and implement measures aimed at mitigating and adapting to its impacts.

Climate Smart Rice Production

Climate-smart rice production is an agricultural practice that seeks to enhance the resilience of rice production systems to the impacts of climate change while also reducing greenhouse gas (GHG) emissions. It involves a range of sustainable practices, such as reducing water use, optimizing fertilizer use, improving soil health, and adopting agroforestry.

Water use is an important aspect of climate-smart rice production, as rice is a water-intensive crop. To reduce water use, farmers can adopt alternative wetting and drying (AWD) or aerobic rice cultivation. AWD involves alternating the periods of flooding and draining of the rice fields, reducing the amount of water used by up to 30%. Aerobic rice cultivation, on the other hand, involves growing rice in well-drained soil, reducing water use by up to 50% (Zizinga, 2022)

Fertilizer use is another important aspect of climate-smart rice production. Excessive fertilizer use contributes to GHG emissions and can also harm the soil and water quality. To optimize fertilizer use, farmers can adopt site-specific nutrient

management, which involves applying the right amount of fertilizer at the right time, based on the soil and crop requirements (International Fertilizer Association, 2016).

Improving soil health is also an important component of climate-smart rice production. This can be achieved through practices such as crop rotation, the use of cover crops, and conservation agriculture. Agroforestry, which involves integrating trees into crop production systems, can also help to improve soil health, provide shade for the crops, and reduce GHG emissions (Jat, 2019).

In conclusion, climate-smart rice production is an important step towards enhancing the resilience of rice production systems to the impacts of climate change, while also reducing GHG emissions. The implementation of these practices can contribute to sustainable agriculture, food security, and the health of our planet.

Fisheries Breeding in Rice Fields as done in China – Why not in Pakistan.

Fisheries breeding in rice fields refers to the practice of raising fish in rice paddies in an integrated aquaculture system. This practice has been widely adopted in many regions of China and has become a significant contributor to food production and rural livelihoods (Freed, 2020).

Rice paddies provide ideal conditions for fish breeding, as they provide a large water surface area and a relatively stable water temperature, which can be controlled through the irrigation system. Additionally, the nutrient-rich water from the rice paddies provides an ideal environment for fish growth. This practice can also help to reduce the use of chemical inputs in rice production, as fish excretion can act as a natural fertilizer for the rice plants (Coche, 1967).

Fisheries breeding in rice fields can provide a variety of benefits, including increased food security, improved income for rural communities, and reduced environmental impact. In addition, the integration of aquaculture with agriculture can help to increase the productivity of the rice fields, as the fish can help to control pests and weeds, and the rice plants can provide shade and shelter for the fish (Freed, 2020).

However, the practice also has some challenges, such as the risk of disease transmission between the fish and the rice plants, and the need for adequate water management and monitoring to ensure sustainable fish production. In addition, there is a need for effective policies and regulations to ensure the sustainable development of this practice, and to support the livelihoods of the farmers who are engaged in it (Coche, 1967).

Fisheries breeding in rice fields is an innovative and promising practice that offers multiple benefits for food production, rural livelihoods, and the environment. With effective policies and regulations in place, this practice has the potential to contribute to sustainable agriculture and food security.

In Pakistan, fisheries breeding in rice fields is a relatively new practice, but it has the potential to contribute to food security, improve rural livelihoods, and reduce the environmental impact of agriculture in the country. The integration of aquaculture with rice production can increase the productivity of rice fields and provide additional sources of income for farmers.

In Pakistan, the practice of fisheries breeding in rice fields is still in its early stages, but it is gaining popularity in some regions of the country. The warm and humid climate in many parts of Pakistan provides ideal conditions for fish breeding, and the water from rice paddies can be used to raise a variety of fish species, including common carp, catfish, and tilapia. There are several examples of rice fields with fish farming in Pakistan in Okara District, Punjab, Mianwali District, Khyber Pakhtunkhwa, Bahawalpur District, Punjab, and Charsadda District, Khyber Pakhtunkhwa.

The success of this system relies on the adaptability of the fish species used, the benefits it provides to farmers, and the positive impact it has on the local environment and food security.

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VAGARIES OF CLIMATE CHANGE

By:

Durdana Najam

The climate is defined as long-term averages and variations in weather measured over multiple decades

The Earth's atmosphere has a limit on the extent to which it can absorb heat. Heat or energy is proportionally divided into different greenhouse gases (GHG). These gases, water vapour, carbon dioxide, methane and nitrous oxide are essential for the earth's balance. The excess proportion of GHG can result in cumulative damage to the infrastructure, health and quality of air and water we consume. Nature's process of replenishing CO2 through photosynthesis, respiration, weather rocking and decomposition has been severely affected by the release of additional CO2 from fossil fuel burning, deforestation and land use changes, to name a few. The mismatch between the rate of CO2 emission from human activities and nature's ability to process it has been the significant reason for the imbalance in the correct quantity of greenhouse gases. Carbon dioxide has been the worst affected gas. Once in the atmosphere, the carbon remains stored there for decades or centuries and thousands of years.

This article aims to look at the impact of climate change in the context of human behaviour. Things we consume, discard or discharge into our environment directly affect the health of the atmosphere that we live, inhale and depend on for survival. We have only three choices: mitigation, adaptation or suffering. Other than these remedial actions, we do not have the luxury of taking the clock back to when human beings started messing with nature in their zest for progress and development.

The climate is defined as long-term averages and variations in weather measured over multiple decades. The earth's climate system includes the land surface, oceans, atmosphere and ice. Scientists have argued that the climate is changing and it is changing rapidly because of human activities. The impact of climate change is manifest in various weather conditions, such as an increase in the number of scorching days, less extreme cold days, more precipitation events, more floods and more droughts.

All these changes happen in almost every corner of our planet at different times. We humans emit around 50 billion tonnes of CO_2 annually. A 40 per cent increase from the emissions in 1990, when we emitted 35 billion tonnes. Our irresponsible behaviour towards the earth since 1990 has resulted in the following physical impacts.

Climate change alters the geophysical, biological and socio-economic systems by exposing them to the impacts of weather changes. Some systems are more vulnerable to these changes than others. Their ability to cope with the impact of climate change depends on the degree of disaster or hazard. The unpredictable nature of climate change has made it more complicated and risky.

Not all socio-economic groups are vulnerable in the same measure to the impacts of climate change. This raises the question of equity. For instance, countries built on islands are more vulnerable to sea-level rise than other. Semi-arid regions are more vulnerable to drought and heat waves. The impact of vulnerabilities also manifests in the increased risk of contracting diseases, malnutrition and mass migration.

Risk is the function of exposure, vulnerability and hazard. Literature on climate change divides climate-related risk into two categories: Physical risks and transition risks. Physical risks are associated with changes in climate and weather with an impact on economies. Physical risks have two sub-categories: Acute physical hazards and chronic physical hazards. On the other hand, transition risks are about risks faced during the transition from fossil fuel to a low-carbon economy

In the World Economic Forum's Global Risk Perception Survey 2023 report, the top six risks confronting our planet, over the short and long term, are related to climate change

Of all the risks of climate change, biodiversity loss is perhaps the biggest threat.

In ten years, as reported by the World Economic Forum Risk Report 2023, the deadly interpenetration of biodiversity loss, pollution, diminishing natural resources and climate change will make a devastating mix.

When almost half of the world's economic output is dependent on nature, any collapse in the ecosystem will be detrimental to economic and societal well-being.

Risks from loss of biodiversity are: increased occurrence of zoonotic disease; decline in crop yields and nutritional values; increased water stress giving rise to violent conflict; loss of livelihood dependent on food systems and nature; erosion of pollination, water meadows and coastal mangroves; and deterioration of natural flood protection systems.

Climate-Related Disasters (CRD) leaves a trail of health issues for the survivors. Injuries and psychological illness are common ailments among CRD-affected people.

The WHO has acknowledged climate change's impact on health. Extreme heat has been responsible for deaths from cardiovascular and respiratory diseases. Heavy rainfall and floods, especially in underdeveloped and developing countries, increase malnutrition, the rate of infection and, in many cases, the incidence of cancers. The two evils of climate change concerning human health are air pollution and rising temperature.

Communicable diseases after floods, cyclones and droughts are equally common. The incidence of infectious diseases depends on the type of hazard and the availability of resources to the affected population. Daviz Simango, the Mayor of Beira, Mozambique, once said these words about flooding in his region: "Every year a thousand people die here from cholera that is spread by flooding, and during the rainy season, many people are forced out from their homes."

Experts believe that even if we manage to keep the global warming limit to well below 2 degree Celsius as agreed by the United Nations in the Paris Agreement by 2030, climate change's impact would still threaten human societies and ecosystems.

Our only alternative is to spend on adaptation and building resilient infrastructure.

On the occasion of the Paris Accord in 2015, Kings Charles of Britain, then a Prince, in his opening remarks, explained the vagaries of climate change in these words: “Humanity faces many threats but none is greater than climate change. In damaging our climate we are becoming the architects of our own destruction. We have the knowledge, the tools and the money (to solve the crisis).”

Courtesy The Express Tribune, June 22nd, 2023

With Permission of the Author

DESIGN AND CONSTRUCTION OF HYDROPOWER PROJECTS ON IRRIGATION CANALS IN PUNJAB PAKISTAN

By:

M.H. Mahu[1], PhD

Abstract: Small hydropower projects on irrigation canals have been constructed with total installed capacity of 19.88 MW in Punjab Pakistan. The scope of work comprises of construction of a diversion power channel, powerhouse, gated spillway, tailrace, raising of existing embankments, excavation of canal, installation of sets of double regulated horizontal shaft Kaplan turbines, sets of digital electro hydraulic governors, sets of draft tubes with hydraulically operated roller gates and sets of power intake trash racks and stop logs. Two plants at Pakpattan on Pakpattan canal and at Marala on Upper Chenab canal are successfully in operation since 2017 and have been connected to national grid. Chianwali project is under commercial operation and planned to connect to national grid in October 2023. Deg outfall project has been built in 2017. During its initial operation, the spillway was settled downed. The hydraulic and structural design of the project was reviewed and investigated. The spillway reconstruction is in process and planned to connect to national grid in December 2023. Low head technology is used due to less drop available up to 4m. The cost per megawatt is about US$ 4 million. The paper covers unique features about design and construction of four hydropower projects which are beneficial to the humankind especially hydropower engineering profession.

Keywords: Small hydropower, irrigation canal, model study, Upper Chenab canal, Pakpattan canal

1. Preamble

Prime object of irrigation canals is to supply water to farms fields for agriculture production. However, these canals are used as a bye product for energy production. Four small hydropower projects having heads up to 4 m have been constructed on irrigation canals in Punjab Pakistan. The Pakpattan hydropower project achieved commercial operation in February, 2017. The project was completed at a project cost of US$ 10.64 million (Pak rupees 1787 million). The plant is successfully in operation and has been connected to national Grid. Marala hydropower project has been completed at a project cost of US$ 30.90 (Pak Rupees 4545 million and achieved commercial operation in November 2018. Chianwali hydropower project has been completed at a project cost of US$ 21.14 million (Pak Rupees 3568 million) and shall achieve commercial operation in October 2023. Deg Outfall hydropower project has also been partially completed at a project cost of US$ 16.41 million (Pak Rupees 2508 million) and shall achieve its commercial operation date on December 2023. Coronavirus Covid-19 Epidemic has also caused adverse impact on the progress of Chianwali and Deg Outfall hydropower projects. This paper express the details of design and construction aspects of one hydropower

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power project on Pakpattan canal and three hydropower projects on Upper Chenab Canal in Punjab Pakistan. The location map of four hydropower projects is shown in Figure-1.

2. Projects Layouts

The major principles considered for design of projects layouts are (a) no adverse influence on the safety and operation of the canal (b) the design flow capacity of canal is not impaired (c) convenient for construction (d) feasible in technology (d) convenient for operation and management (e) hydraulic aspects of the curves of headrace and tailrace channels is satisfactory. The details of each layout plan is described below.

2.1 Pakpattan Hydropower Project

A low head run-of-canal Pakpattan hydropower project with installed capacity of 2.82 MW has been constructed in district Pakpattan on Pakpattan canal which offtakes from Sulemanki barrage with the design head discharge of 186.75 m3/s. The layout of project is planned in such a way that the main canal was continue flowing without obstruction, powerhouse and spillway as an adjoining structure are constructed on the right side of the main canal in power channel at Rd 114+636. A connecting headrace and tailrace channels are formed on the right side of the main canal with the design capacity of 112.57 m^3/s. The plant has two units and design discharge of each unit is 40 m^3/s. The total design discharge of the plant is 80 m^3/s. The powerhouse is constructed at Rd 114+636 by combining heads of two falls to achieve better head between two falls at Rd 112+350 and fall Rd 124+950. A rated net head of 4.20 m has been found suitable for determination of installed capacity. The net head and power potential are computed at different discharges ranging from 12 m^3/s (minimum discharge of one turbine) to 112.57 m^3/s. The installed power potential and annual energy production have been computed as 2.82 MW and 21.67 GWh with plant factor 84.38%. Plant factor is the ratio of average generated power by the plant to the maximum power that could have been generated for a given time period. As this power house is constructed over the perennial existing irrigation canal system so the annual maintenance closure period is deducted for the energy calculation. The layout plan of Pakpattan hydropower project is shown in Figure-2.

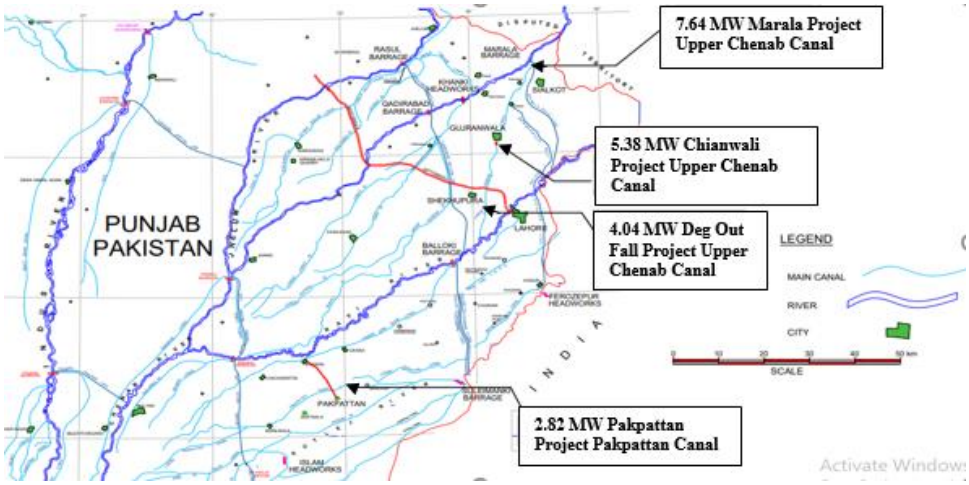

Figure-1. Project locations map of hydropower projects on irrigation canals in Punjab Pakistan

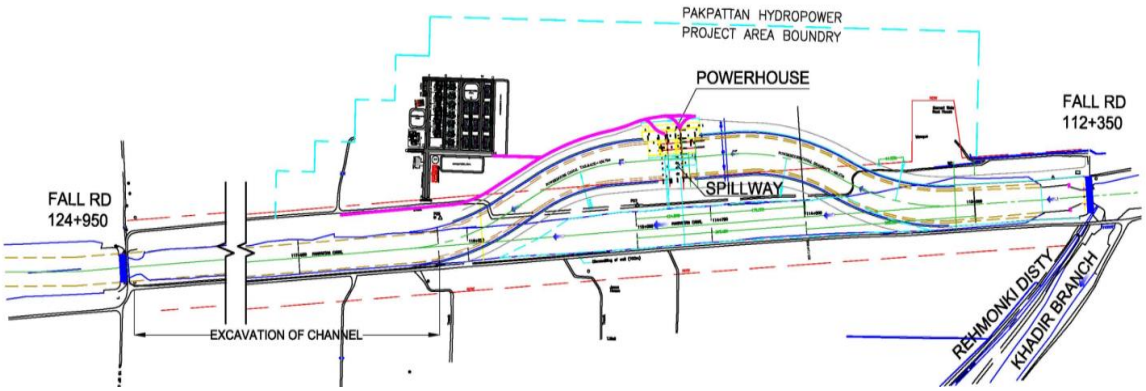

Figure-2. Layout Plan of Pakpattan Hydropower Project

2.2 Marala Hydropower Project

A low head run-of-canal Marala hydropower project with installed capacity of 7.64 MW has been constructed in district Sialkot on Upper Chenab Canal downstream its head regulator at about Rd 2+850 in bypass arrangement. The site is located about 305 m downstream of the main Head Regulator of canal and about 25 km north of Sialkot city. The project uses the fall at diversion canal to produce power output at rated discharge of 420 m^3/s and electricity production of 43.37 GWh per year at plant factor 65.56%. The project layout arrangement consists of a gated spillway at Rd 3+155 in the existing canal with designed discharge of 555 m^3 /s and a powerhouse at Rd 3+436 in bye-pass power channel on right side of canal with a design discharge of 420 m^3 /s and having four units. As per longitudinal section of canal, the maximum designed discharge of canal at Rd 0+000 is 477.14 m^3/s. The higher discharge for spillway capacity was fixed on the basis of future irrigation requirements. Net head and power potential are computed at different discharges ranging from 31.5 m^3/s (minimum discharge of one turbine) to 477 m^3/s. A rated net head of 2.16 m has been found suitable for determination of installed capacity. The layout plan of Marala hydro project is depicted in Figure-3.

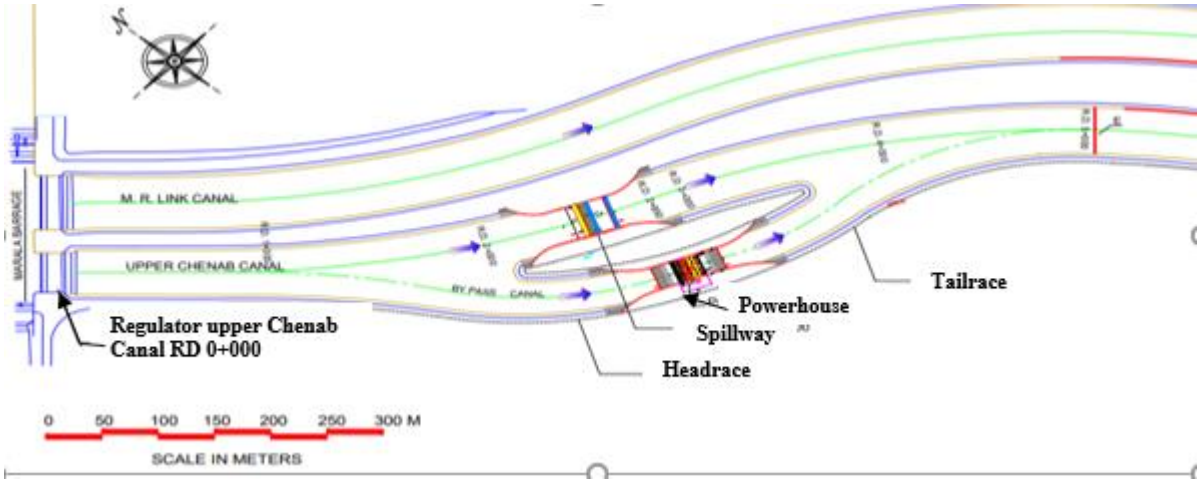

Figure-3. Layout Plan of Marala Hydropower Project

2.3 Chianwali hydropower project

A low head run-of-canal Chianwali hydropower project with installed capacity of 5.38 MW has been constructed in district Gujranwala on the Upper Chenab Canal between Rd 129+000 to Rd 133+000. The powerhouse is constructed at Rd 131+250 having two units with unit discharge 75 m^3/s and design head 4.2 m. The plant shall generate average annual energy of 28.82 GWh at plant factor 59.88%. The power house has been constructed on the diversion channel to save the implementation time while sub-station and operation and maintenance colony on the right side of the canal. There are two falls structures at Rd 128+000 and Rd 164+000 which was combined at Rd 131+117 to have the required head to run the power plant. A feeder channel has been constructed in the right of way of the main canal to feed the distributaries in Sheikhupura, Akbar and Harpoki at Rd 163+000. The powerhouse is located at RD 131+117 about 600 m downstream of existing fall structure at RD 128+000 towards the left bank of the canal to make maximum use of the existing road for construction purposes. The powerhouse and spillway are placed adjacently along the same axis. An access road is realigned to pass over the powerhouse draft tube and spillway to connect the existing right bank road. Construction of feeder canal and associated structures to ensure the required discharge for three off taking distributaries downstream of Powerhouse was also part of the project. The layout plan of Chianwali hydropower project is shown in Figure-4.

2.4 Deg Outfall Hydropower Project

A low head run-of-canal Deg Outfall hydropower project with installed plant capacity of 4.04 MW has been constructed in district Sheikhupura in by-pass arrangement opposite Rd 282+225 of Upper Chenab Canal. Upper Chenab Canal (Main Line Lower) is controlled from Bombanwala head regulator. The designed discharge of the head regulator is 315 m^3/sec. A number of fall structures exist along this canal where hydropower projects can be developed. The project mainly consists of combination of two falls Rd 266+000 and Rd 283+100 to utilize the head for energy output. A power canal in a bypass arrangement situated at right side of canal between Rd 280+400 and Rd 283+819 and the power house was constructed midway opposite Rd 282+225 of canal. It includes intake section, gated spillway, power house and tail race section. The bed level and the embankment of the power canal upstream of power house was constructed to the existing level of canal upstream of the fall structure at Rd 266+000. The power canal downstream of the power house was designed and constructed to the bed level of canal at Rd 283+819 in accordance with the bed level downstream of fall structure at Rd 283+100. The plant has two units with design discharge 120 m^3/s and shall generate average annual energy of 26.46 GWh at a plant factor of 74.52%.The layout plan of Deg Outfall hydropower project is shown in Figure-5.

3. Civil Works

Major scope of civil works in these four hydropower projects include construction of power canal works in bypass arrangement, construction of tail race canal works in by-pass arrangement, raising of existing canal embankments from upstream of powerhouse location according to remodeled cross sections, excavation of canal from downstream of powerhouse according to remodeled cross sections, construction of new district road bridges and village road bridges on canals, gated

spillway structure with service bridge, construction of protection works, powerhouse buildings and ancillary structures including machine hall, control building, intake and outlet bays with cut-offs, and retaining walls in power canal etc.

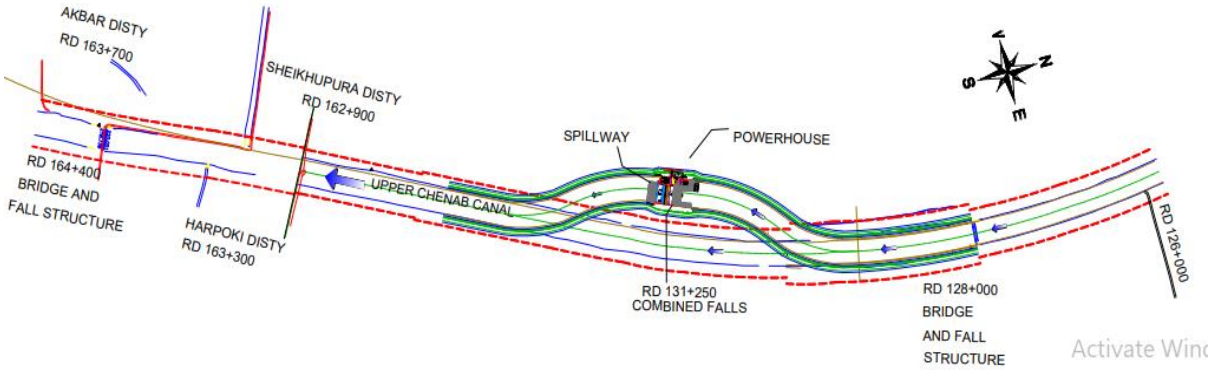

Figure-4. Layout Plan of Chianwali Hydropower Project

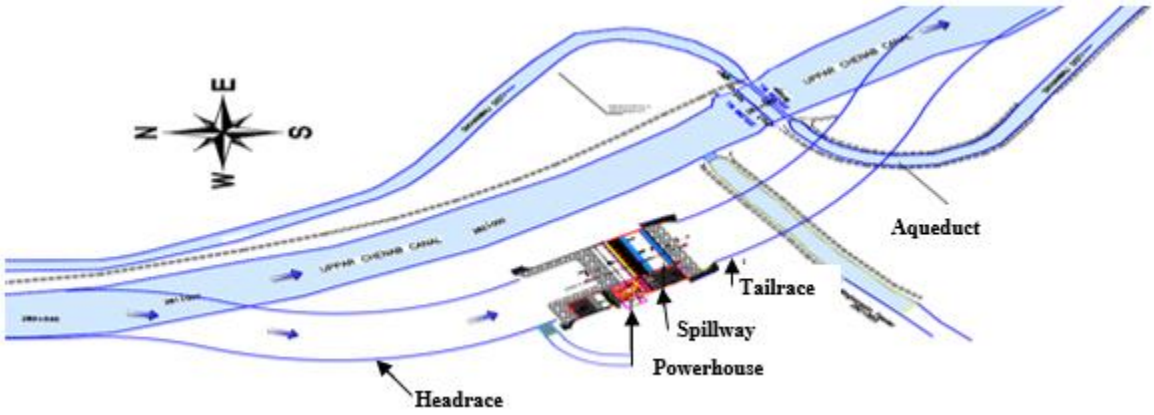

Figure-5. Layout Plan of Deg Outfall Hydropower Project

4. Power Potential and Annual Energy

Power potential and annual energy production are computed using the following basic formulas.

$$P = \eta\,(\gamma . Q . H_{net})/1000 \quad (1)$$

where P is the Power Potential in MW, H_{net} = H_{gross} – Losses in powerhouse and H_{gross} is the difference of constant HWL and variable TWL, γ is the unit weight of water, three types of efficiencies are involved in the above formula which are as followings:

$$\eta_{total} = \eta_{turbine}\, x\, \eta_{generator}\, x\, \eta_{transformer} \quad (2)$$

$$\text{Annual Energy Generation (GWh)} = P\,x\,(\text{No. of operating hours in year})/1000 \quad (3)$$

The turbine efficiencies under different scenarios of discharge availability for power have also been computed while the generator and transformer efficiencies are taken as fixed i.e., 0.96 and 0.98 respectively. These are estimated efficiencies which are used for annual energy production. The losses play a very important role in the electrical machine design. To achieve an optimum design, the losses must be minimum and accurately predicted to guarantee the highest efficiency of the

machine at a minimum cost. The efficiency of the generator was given in terms of the standards of IEEE115, which is recognized and adopted in GE and most of the international manufacturers of generators. The actual efficiency of the generator mentioned in section 10 of the paper is guaranteed. 11 KV three phase power transformer is designed in compliance to IEC60076.

4.1 Energy Production

The gross head across for the proposed powerhouse depends on the difference of Head Water Level (HWL) and Tail water Level (TWL). The TWL in downstream reach of powerhouse is not controlled and tail water rating curve is used to assess the tail water level corresponding to range of discharges. However, the HWL depends on the operation of canal reach upstream of powerhouse. A constant HWL at the canal's designed FSL upstream of powerhouse is considered while the daily tail water levels for downstream of powerhouse is estimated using discharge rating curve of tailrace just downstream of powerhouse. The downstream releases of powerhouse are adjusted on daily basis to keep the HWL constant throughout the year.

4.2 Head Losses in Powerhouse Structure

The head losses have been estimated for the entire water way up to the turbines. These include the local losses in existing fall, at ends and transitions in headrace, in trash racks, in gate / stop log slots, etc. The friction losses in the headrace channel have been subtracted from the designed water level at upstream of fall structure using the remodelled bed slope of canal. Head losses are estimated as per criteria given in USBR's design of small dams and Layman's Guidebook and Guidelines for Hydraulic Design of Small Hydro Plant by Indian Institute of Technology, Roorkee. Due to limited length of the paper, calculations are not made part of the paper. However, head losses in powerhouse are summarized in Table-1. Following types of head losses in the powerhouse have been considered.

4.2.1 Losses on Upstream of Powerhouse

1. Entrance loss due to contraction (from headrace to upstream approach of powerhouse)
2. Slope loss in upstream approach of powerhouse (due to friction)
3. Entrance loss due to contraction (from upstream approach to intake bay of powerhouse)
4. Trash rack loss
5. Entrance loss due to vertical contraction (at start of pressurized flow)
6. Loss due to miscellaneous uncounted factors (max. of the above 5 number losses)

4.2.2 Losses on Downstream of Powerhouse

1. Exit loss due to expansion (from downstream exit of powerhouse to tailrace)
2. Slope loss (from outlet bay to downstream exit of powerhouse)
3. Exit loss due to expansion (from draft tube to outlet bay)

Table-1: Head Loss Estimations

Project	Disch. (m^3/s)	1	2	3	4	5	6	7	8	9	Total H. loss (m)
Pakpattan	80	0.010	0.003	0.004	0.045	0.001	0.045	0.023	0.042	0.013	0.186
Marala	420	0.007	0.006	0.029	0.056	0.001	0.056	0.007	0.021	0.004	0.187

5. Hydraulic Model Study

Physical model of four projects was constructed with geometrical scale of 25 at hydraulic field station Nandipur, Gujranwala. The purpose of the model study was to determine the discharge capacity of proposed powerhouse and spillway, gated and un-gated flow conditions through spillway, flow conditions in headrace and tailrace to establish optimal curvatures, water levels in headrace and tailrace at design discharge of powerhouse, stability of stone pitching and apron at various flow conditions and when sudden shut down of powerhouse occurs creating surge in headrace, extend/height of surge and its impact on head regulator along with its celerity and normal functioning of existing irrigation system after construction of powerhouse. Due to limited length of the paper, it is difficult to explain all the details of the model study. However, the results of model study for Marala hydropower project are presented here. After model verification, the experimentation was made under different 10 tests. The position of spillway was tested at two locations at RD 3+155 and RD 2+756. After hydraulic performance of spillway and power house at two locations, the location of spillway at RD 3+155 was found suitable for power house in all operational stages of turbines with the following conclusions.

- Powerhouse passed the design discharge 420 m^3/s with uniform distributions through four turbines with upstream water level as 246.74 masl in the headrace channel
- The flow all along the banks of headrace channel remained friendly without showing any negative impact on the embankments of the channel and no eddy was formed in front of powerhouse
- The island between powerhouse and spillway diverts the required flow for power house according to the design discharge without having erodible velocity along its bank due to modified elliptical nose of island
- The surge height of about 0.95 m was generated due to sudden shut down of all units of power house and its intensity reduced as it travelled towards the head regulator of UCC subsequently opening of spillway gates, it is recommended to keep the free board 1m excess of this surge, 2m from normal water level.
- In the construction, all recommendations of the model study were implemented.

6. Hydrology

The flow duration curve of Pakpattan canal at powerhouse location Rd 114+636 of Pakpattan hydropower project indicates that for each year of the part of historical period from 1991 to 2000, 80 m^3/s remained available for more than 30% of time

(110 days) while for each year of the historical period from 2001 to 2010, 80 m^3/s remained available between the ranges of 25% of time (91 days) to 0% of time. Upper Chenab Canal is a perennial canal with variation in discharges in Rabi and Kharif season and remained closed normally from December 26 to January 14 for annual maintenance purposes. The summer and winter seasons have been considered from 16 April to 15 October and 16 October to 15 April respectively. The analysing the 28 years data (1984 to 2011) shows that 420 m^3/s remained available for about 3.5% of time. The selection of high value of discharge was based on future needs of irrigation of canal. The flow duration curve of Upper Chenab Canal at powerhouse of Chianwali hydropower project indicates that nine years data (2000 to 2009) shows that 150 m^3/s remained available for about 11% of time. The flow duration curve of Upper Chenab Canal at powerhouse of Deg Outfall hydropower project indicates shows that 120 m^3/s remained available for about 17% of time based on the flow data (2000 to 2009).

7. Spillway and stilling Basin

Spillway is designed on the full supply discharge of the canal in that reach so that in case shut down of powerhouse, the whole water can be passed through the spillway. In addition, to provide sufficient capacity, the spillway is hydraulically and structurally adequate and is located so that spillway discharges do not erode or undermine the downstream toe of the structure. For design of stilling basin on these hydropower projects, several factors such as; nature of foundation, approach Froude number, impact angle of flow with respect to stilling basin floor, tail water level and economic considerations have been considered. For interest of readers, only technical details are included in the paper for spillway and stilling basin of Marala hydropower project.

7.1 Spillway

The gated broad crested spillway is provided for 555 m^3/s which is about 16% higher discharge of the full supply discharge of Upper Chenab Canal. Energy dissipaters are provided to dissipate the energy of the falling water at the bottom of spillway and various essential factors required for optimal performance of spillway were considered. The Spillway has nine bays each 7.62 m long and has eight piers each 1.50 m wide. The spillway crest level of 243.688 masl has been adopted after a series of trials with higher and lower elevations. Higher crest elevation results in making the crest length more than 68.580 m. A number of crest widths have been studied. It has been found that a total crest width of 80.579 meter (9 bays of 7.62 meter width and 1.50 meter wide piers) and broad crested shape is capable of passing the maximum design discharge. The resulted maximum surcharge level is 246.744 masl. Upstream chute is provided with slope of 1V to 2H. Width of the crest is provided 2.25 times head on crest to ensure the crest to behave as broad crested. Downstream chute is provided with slope of 1V to 2H. The broad crested spillway is designed according to the following weir formula.

$$q = C_o H_o^{3/2} \quad (4)$$

Where q is the discharge per unit width in $m^3/s/m$, H_o is the total head over the weir (m), C_o is the Coefficient of discharge. The Coefficient of discharge, C_o for the broad crested spillway is adopted as 1.8 (SI system) and 3.09 in Foot Pound System. The

discharge capacity of the spillway was vetted by the physical hydraulic model study results and Coefficient of discharge was also verified by the model study.

7.2 Stilling Basin

The dissipation of energy has been achieved by means of stilling basin. In the stilling basin, the supercritical flow from the spillway is reduced to sub critical flow by a hydraulic jump. The formation of hydraulic jump in the stilling basin leads to dissipation of excess energy. Stilling basin has been designed as USBR Type IV basin. For design discharge, the water depth at the end of the chute is 0.61 m and conjugate depth is 3.16 m while the Froude Number before the jump is 3.99. Chute blocks of 0.61 m wide, 1.22 m high at spacing of 1.52 m have been provided at the start of stilling basin to reduce the length of jump. The stilling basin is 21.03 m long. At the end of stilling basin there is proper end sill which is followed by inverted filters. The elevation of the cistern is 240.335 masl and the tail water level is 244.659 masl. The computed dimensions of spillway and stilling basin were finalized by the Model study results.

8. Head Race and Tail Race Channels

The trapezoidal power channel section with side slope protected with stone and bed unprotected is provided to ensure the stability of side slopes under different operational conditions. The headrace channel is designed for stone side protections with opting the composite Manning's 'n' as 0.0263. The embankments of the canal are made with compacted earth fill with 1v:1.5h inward & outward slopes. Water passes through the spillway or releases from the powerhouse is carried back into canal through tailrace channel. The hydraulic design parameters of headrace and tailrace channels was finalized by the hydraulic model study results conducted at Hydraulics field station Nandipur.

9. Powerhouse

The powerhouse consists of one unit block with required length and one unloading / erection bay. The unloading / erection bay are located at the right side of powerhouse. The powerhouse in the direction of flow is composed of intake structure, powerhouse and draft tube. Fixed trash rack is installed at intake to prevent debris from entering into water passage and turbine. Stop log gates operated by upstream gantry crane are arranged at intake. Powerhouse includes gallery, operating floor and superstructure. The access gallery runs through the whole unit blocks for the convenience of inspection and maintenance. The width and height of Powerhouse are fixed by unit layout and lifting height of equipment. In case of Pakpattan, the powerhouse length is 18 m and 30 m width. In case of Marala project, the powerhouse consists of one unit block with total length of 54.43 m and one unloading / erection bay with total length of 23.00 m. The superstructure includes columns, concrete crane girder and roof steel frame.

10. Hydro electrical and Mechanical Equipment

In case of Pakpattan hydropower project, the two sets of horizontal Pit type tubular Kaplan turbines are provided each with rated output of 1.505MW at rated head of 4.2m and rated flow of 40 m^3/s complete with all auxiliary equipment including regulating gear, turbine casing, guide vanes, thrust and guide bearings, etc. The diameter of turbine runner is 2.6m. In case of Marala project, four sets of horizontal

Pit type tubular Kaplan turbines, each with rated output of 2.022MW at rated head of 2.16 m, rated flow of 105 m^3/s, complete with all auxiliary equipment including regulating gear, turbine casing, guide vanes, thrust and guide bearings, are provided. The diameter of turbine runner is 4.9 m. In case of Chianwali project, two sets of double regulated horizontal shaft Kaplan turbines, each 2.8 MW, with a rated head of 4.2 m, rated flow of 75 m^3/s complete with all auxiliary equipment including regulating gear, turbine casing, guide vanes, thrust and guide bearings are provided. In case of Deg Outfall project, the hydro-mechanical equipment comprises of two sets of double regulated horizontal shaft Kaplan turbines, each 2.12 MW, with a rated head of 4.0 m, rated flow of 60 m^3/s complete with all auxiliary equipment including regulating gear, turbine casing, guide vanes, thrust and guide bearings. When turbine is running at rated speed in the range of operating head and flow, the turbine efficiency and output is guaranteed. In case of Pakpattan, at rated head 4.2 m, turbine efficiency is 91.96%, generator efficiency is 96.03%, and turbine output is 1505 KW. In case of Marala, at rated head 2.16 m, the turbine efficiency is 91.76%, generator efficiency is 96.07% and turbine output is 2022 KW.

11. Construction Works

The implementation of the Pakpattan hydropower project covered duration of 885 days which includes mobilization, detailed design, model study, construction / procurement of plant and equipment, transportation, site installation, testing and commissioning etc. The contractor took extra time of 664 days to complete the project till commercial operation date (COD). The delayed was due to lack of resources by the Contractor. The contractor has been penalized by the employer due to late completion of the project. The matter is under arbitration stage. Photo 1 shows the completed view of spillway and powerhouse of Pakpattan project. The civil quantities executed on the project are concrete in powerhouse 21500 m^3 and in the spillway 4457 m^3, excavation 1917 m^3, filling 2134 m^3 and steel 1645 ton. The construction completion time in Marala project was 900 days but it was completed in 1122 days. The delayed was due to many reasons which includes lack of resources by the Contractor, review of design of Marala hydropower project. Photo 2 shows the completed view of spillway and powerhouse of Marala project. The civil quantities executed on the project are concrete in powerhouse 46000 m^3 and in the spillway 10000 m^3, excavation 3900 m^3, filling 4500 m^3 and steel 375 ton.



Photo 1. View of Pakpattan project looking from downstream



Photo 2. View of Marala project looking from downstream

12. Collapse of Spillway of Dag Outfall HPP

Deg outfall project has been built in 2017. Its spillway with design discharge of 120 m^3/s having seven bays with radial gates was constructed as safety valve for power house to pass excess water in case of shut down /surge. After the substantial

completion of project, its spillway was put in trial operation by diverting the canal flow on 2 February 2017. On 17 February 2017, all of a sudden the spillway collapsed /settled down and suspended supply of irrigation water to huge chunks of agriculture land in several surrounding areas. Photo 3 and Photo 4 depicts the view of settled spillway. The canal was closed on emergency basis to avoid the further collateral damage of the allied infrastructure.

12.1 Reasons of failure of spillway

A concrete separation divide wall separates the spillway from powerhouse in the direction of flow. This divide wall was extended upstream of power house to form inlet bay and also extended in the downstream side. The pit of powerhouse was excavated deeper than the crest of spillway to accommodate the Kaplan turbine as per design. It was observed and investigated that alongside the divide wall on spillway side, the compaction was not done properly and replacement of local material with good quality material as per specification was not made. When water was released in the head race channel, two scour holes were developed by the formation of swirls just 40 m upstream of spillway and 74 m downstream of spillway on its right side from plant axis due to loose strata alongside the divide wall. A week zone alongside the separation wall from upstream towards downstream underneath the spillway was found after detailed soil and geotechnical investigation. The failure of spillway occurred due to slippage of sub soil into the scour hole by water pressure and ultimately undermined of the foundation soil beneath the spillway.

12.2 Remedial measures

The failure of spillway created serious doubts on the credibility of design & quality assurance of the Deg Outfall Project and other hydropower projects which were under construction at that time (Chianwali and Marala). The hydraulic and structural design of the all four projects were reviewed and investigated. A detailed condition survey was carried out to evaluate the condition of remaining structure and also for overall project rehabilitation. The contractor took responsibility for its failure and made rehabilitation works at its own cost. The model study was again done with the modification. The spillway was separated from powerhouse by well compacted earthen island with concrete retaining wall around it. All these activities including design review took considerable time and commercial operation date revised with the approval of Employer. The construction work is near to complete.



Photo 3. View of settled spillway looking from upstream



Photo 4. View of settled spillway looking from downstream

13. Dispersal of Power

For the dispersal of power, Pakpattan project has been connected through single circuit 11 KV overhead transmission lines with national grid power system at Pakpattan city with 66 KV sub-station at a distance of about 12km. The transmission line is designed as per grid specifications and standards. The regulator (NEPRA) has approved tariff at US cents 7.1757 per kWh (Rupees 7.3855 per KWh). The generated energy is being evacuated to Pakpattan grid station through a pre-COD sale agreement signed with Multan distribution co. Till now, the units generated as of June 30, 2022 are about 53.32 GWh. For the dispersal of power, the Marala project has been connected through single circuit 11 KV overhead transmission lines with national grid power system at Marala head works 66 KV sub-station at a distance of about 2km. The regulator (NEPRA) has approved tariff at US cents 8.5492 per kWh (Rupees 8.7997 per KWh). The units generated till June 30, 2022 are 87.21 GWh. The transmission line of both Chianwali and Deg Outfall projects have also been completed. The regulator has approved Tariff for Chianwali and Deg Outfall as US cents 10.7410 per kWh (Rupees 11.0561 per KWh) and US cents 8.6114 per kWh (Rupees 8.8640 per KWh) respectively.

14. Problems during construction

In case of Pakpattan, one of the problems during the construction stage was the model study conducted by the Research institute at Nandipur. The detailed design was made by the contractor and vetted by the Punjab Irrigation Department. It took considerable time to vet the model study. The other contract problem faced during construction stage was the change of manufacturer of equipment for the plant. Due to poor response and week process of providing information for the change of manufacturer as per bank requirements, the delay was happened to finalize the manufacturer of equipment of the plant. In case of Marala, during construction, one of the major problems was dewatering of construction area of power house, inlet bays and outlet bays. It was contractually required to keep water table 1m below excavation line of power house. About 68 number water pumps of 0.0354 m^3/s capacity each were installed on project area to keep ground water level down enough from bottom line of excavation. These were worked 24 hours a day throughout the project duration. During construction when inlet slab and outlet bays slabs have been constructed and power house partially completed, the site in charge thought to shut off all the pumps, eventually, due to /uplift pressure, the inlet bays slab were lifted up and water was oozed out from broken joints. Water stop all along the upstream retaining walls inside the upstream inlet bays were worn. Same situation was also happened on outlets bays. Different remedial options were considered to rectify the problem. The contractor put an overlay of concrete of 0.6m over the already poured slab of inlet and outlets bays to increase the dead weight at his own cost. Other major cause of delays were delay in model study, contractor general management issues, general hindrances in canal closure related works, single contractor on all four projects.

15. Lessons Learnt

The tasks for pre-construction stage i.e., appointment of consultants, review of feasibility studies, preparation of tender level designs / tender documents, International Competitive Bidding for EPC/Turnkey Contracts, technical and financial

evaluation of bids was completed under the Asian Development Bank procedures. However, project was delayed due to delay in approval project by upper forums and loan signing, time taking procedures of bank and interdepartmental approvals, review of policy/bank loan and site specific issues and change in designs during tender design stage. The layout with power house in bye-pass arrangement was finally implemented. Due to very low heads, the turbines are of large size with additional requirements of gear box to have the required speed for generators. The feasibility costs of plant and equipment of large size were estimated less as compared to the actual cost of very low head technology. The cost of land acquisition, resettlement and compensations, also increased as permanent land acquisition was considered essential due to site offices, colony and to avoid implications of EPC designs. The costs of employer's facilities were provided on lump sum basis. The consultants defined the employer's essential requirements during construction and operation which increased the project's cost.

16. Conclusions

The unique features of hydropower projects constructed on irrigation canals, design and construction aspects are presented in the paper. Based on the above, following conclusions are drawn.

- Tariff for small hydropower projects on irrigation canals ranges between US cent 7.10 to 10.70 per kWh
- Layout with power house on by-pass arrangement has significant advantage. Such layouts plans are free of diversion, associated canal closures and construction of power house, as a critical task
- Four hydropower projects are based on combination of canal falls at a distance of 7 to 10 km apart in order to have maximum water head to avail very low head technology. Due to elimination of the falls, remodeling of canals including huge excavations, filling, and reconstruction of new bridges, canal structures / regulators and feeder channels are the additional works which increased the cost.
- Cost per megawatt of very low head hydropower projects on irrigation canal falls in Punjab may not be compared with cost per megawatt of medium and high head hydel projects due to site specific issues, size of plant / economy of the scales
- Diversion channel length followed the standard design practice of hydraulics to avoid sharp curves with abnormally less radius for large canal
- Construction of diversion of a large canal with huge quantum of earth work involved significant cost and time as a critical task related to canal closure
- Construction of upstream and downstream coffer dams, protection works and constant watching for three years is also a cost component

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