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

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PAKISTAN ENGINEERING CONGRESS

MID TERM SYMPOSIUM ON 23RD FEBRUARY 2019 ON THE TOPIC OF

"WATER SCARCITY: STRATEGIC APPROACH"

KEYNOTE ADDRESS

By

ENGR. CH. GHULAM HUSSAIN

CONVENER

The Honorable Chief Guest

Engr. Mahmood ul Hasan Siddiqui

Advisor irrigation Department, Punjab.

Congress Members,

Fellow Engineers, Ladies and Gentlemen!

Assalam-o-Alaikum

It gives me great pride to inform that, as a norm, Pakistan Engineering Congress convenes mid-term symposia during the incumbency tenure of various managements to address the technical issues of national importance. Not only this, but the papers presented and discussed and recommendations resulting from the events, are published and disseminated complimentarily by the Congress to all concerned, particularly Federal and Provincial Government Agencies and various autonomous technical entities.

Ladies and Gentlemen!

Since 1957, 38 such symposia have been convened so far and this is 39th.of the series. Though of global magnitude it has grave implications for Pakistan and is titled:

"Water Scarcity: Strategic Approach"

You are aware that in 1951 Pakistan had per capita surface water availability of about 5300 m^3/s which by now (2018) has dwindled to under 900. According to international criteria, this has placed Pakistan in 'Water Scarce Category'. Unfortunately, on the other hand, the country has hardly 30 days surface water storage capacity, and that too, reducing rapidly due to sedimentation of existing reservoirs and non-construction of any new major dam over the last 40 years. Against this, India has already created storage capacity of about 120 days and and is enhancing it further. Most of the developed countries have constructed storage capacities even upto 220 days.

Ladies and Gentlemen!

Though water is a free gift of nature, human beings are required to realize its immense value and make all out efforts to conserve and use it for socio-economic development in a judicious manner to maximize its benefits. In this context, Pakistan should have also visualized the importance of water for ensuring sustainable economic development, prosperity and food security for the fast growing population.

Indus Waters Treaty of 1960 ceded to India three (3) eastern rivers of Ravi, Beas and Sutlej. Notwithstanding this, construction of Indus Basin Project (IBP) not only replaced this water loss but also established a firm base for further development and management of the available surface water resources. To our bad luck, subsequent planners and policy decision makers failed to capitalize on the opportunity provided by IBP. Consequently, Pakistan is now faced with acute water scarcity along with its dire consequences.

After full commissioning of Mangla and Tarbela Dams under IBP in 1977, the country miserably failed to construct any major reservoir. As per World Bank "Study on Water and Power Resources of West Pakistan-1968" Pakistan should have constructed at least one major water reservoir every decade. Fully engineered Kalabagh Dam, which could be made operational by mid 1990s, was not constructed under the utopian plea of absence of "Provincial Consensus". Thus a purely technical issue, to be resolved through domestic / international expertise, was politicized. Furthermore, aside from Kalabagh Dam, construction of no other major dam could be started due to one reason or another. Simultaneously, about 30 MAF surface water continued to flow into the sea without being utilized for: generating cheaper energy from a renewable source; and development of agriculture and industry.

It is fortunate that due to acute water scarcity of threatening proportions, a national awareness has been sparked through recent decision of the Chief Justice, of Pakistan to immediately take up construction of Diamer Basha and Mohmand Dam Projects. Their completion, even on fast track basis, is going to take between 6 to 10 years.

The country has not only plundered surface water, but played havoc with groundwater exploitation. Presently, about 50 MAF is being pumped to provide for: critical surface water shortage to crops; and municipal and industrial uses. This indiscriminate pumping, mostly through 1.2 million private tubewells, has caused excessive mining of freshwater aquifers accumulated through a recharge from the vast irrigation network established over the last 150 years or so. Besides suffering from inadequate recharge for sustainability, these aquifers are threatened by serious quality deterioration due to intrusion from the adjacent saline aquifers. In the absence of urgent regulatory and management measures by public and private sectors sustainability of these aquifers is perilous.

Rainfall is another precious natural water resource, which can be beneficially harvested for: potable water supplies; domestic and industrial supplies; and groundwater recharge. So far, this potential water resource has received scant attention both in public and private sectors.

Hill torrents in Pakistan drain approximately 65% of catchment area of the country. Amongst these are 16 large Hill Torrents generating about 18 MAF annually. Through a number of hill torrent related studies carried out during the past 3-4 decades, over 1200 sites have been identified where about 13 MAF water can be conserved for effective flood control and regulated irrigation development over an area of about 1.5 million acres. Alas, little efforts have been made so far to tap this valuable potential also.

Ladies and Gentlemen!

Aside from the aforementioned dismal situation on the water supply side, the management and effective utilization picture is also quite disturbing. In this regard, the following particular areas need priority attention:-

i. About 95% of present water use is for agriculture through the largest contiguous irrigated system in the world. The infrastructure being used for this purpose is in a state of disrepair and requires substantial revamping.

ii. Out of average annual canal head diversion of 105 MAF, more than half is wasted in conveying the water to farms through mostly unlined and ill maintained network. For salvaging and conservation of these losses, the following interventions have been tried in the past: -

   a. On-farm water management projects were executed over the last 4-5 decades covering a part of over 1 million water course commands in the Indus Basin, through improvements of farmer's ditches including selective lining and provision of 'Pacca Naccas". Though providing significant initial relief, the benefits of these projects frittered due to lack of sustained O & M by the concerned Water Users Organizations (WUAs) established through the farmers.

   b. Lining of distributaries and minors was undertaken to salvage losses in the secondary irrigation system. In this case also, much progress could not be made due to financial and institutional constraints. Furthermore, their proper maintenance including periodic silt clearance suffered due to the basic reason that water charges hardly covered about 25% of O & M charges.

   c. To salvage sizeable on-farm water losses:

      - Farmers were subsidized to adopt rough and precise land levelling but with very limited success including lack of follow up.
      - Farmers were advised to discard age old wasteful flood irrigation practice and adopt furrow irrigation, but in this case also limited success was achieved.

   d. To significantly reduce crop water requirement, attempt was made to introduce higher efficiency irrigation systems (HEIS) including sprinkler and drip irrigation system. Here also, the effort has not gone beyond pilot stage.

Though the present non-agricultural municipal and industrial water use is not significant, it is progressively increasing to cope with the requirements of our

burgeoning population. Management and utilization aspects in this regard are also alarming as is evident from:-

i. Highly wasteful use of municipal water and its untreated disposal into natural water bodies causing extreme pollution and environmental hazards. If treated, this water could be recycled for agricultural and other non-consumptive uses.

ii. Uncontrolled and extravagant use of water by industries and its untreated disposal into nullahs / rivers causing also extreme pollution and environmental hazards.

iii. Seepage of untreated municipal and industrial waste water into fresh aquifers causing biological and chemical contamination with endangered sustainability.

Ladies and Gentlemen!

It can be appreciated from the foregoing that strategy to cope with looming water scarcity demands holistic approach. The instrument to accomplish this is adoption of Integrated Water Resource Management (IWRM) covering:-

i. Water resources development and management.

ii. Efficient water utilization backed by synergic public and private sector efforts in the areas of irrigation, agriculture, municipal water supplies and industrial use.

Ladies and Gentlemenk!

In this Symposium, 11 papers are going to presented by eminent experts and professionals. These will invariably cover various aspects highlighted in my address and hopefully help in recommending an appropriate way forward.

Thank you

REMARKS BY THE CHIEF GUEST

Engr. Mehmud-ul-Hassan Siddiqi T.I
Consultant Irrigation Department, Punjab

AT

MID-TERM SYMPOSIUM

ON THE THEME OF

"WATER SCARCITY-STRATEGIC APPROACH"

On

Saturday, February 22, 2019

WATER SCARCITY IN PAKISTAN

1. Water is life, nothing can survive without water. The God almighty has also stated in the Holy Quran that water was provided through rainfall on the dry and dead earth for its revival

2. Water is essentially required for meeting the domestic, Agricultural, Industrial Municipal and environmental requirements. God has blessed Pakistan with plenty of water, but it requires proper planning to use this water to meet the aforesaid requirements.

3. Agriculture is the main stay of Pakistan economy. The chief input for Agriculture is water. On emergence of Pakistan in 1947 the water availability was about 5650 cubic meters per capita which has now reduced to less than 1000 cubic meters. Thus, the country which was surplus in water in 1947 -48 has become water short country.

4. The main source of water availability are the Indus Basin rivers which are fed by snow melt as well as heavy monsoon rains. The river flows are varying from month to month and season to season. During the period April to mid-June the normal river flows are far less than the Agricultural requirements. However during the period mid-June to mid-September, the rivers are in flood and surplus water is available which not only causes heavy flood damages along the river courses but is wasted by escapage to sea. During the winter months starting from October to March the river flows are again insufficient to meet the crop requirements. As such in order to sustain and boost the Agricultural production it is necessary that the surplus flood water is stored by constructing reservoirs and used during the period of shortages i.e. early Kharif period of April to mid-June and Rabi period from October to March.

5. Every year Pakistan Government has to spend millions of rupees to repair the flood damages. These damages occur due to heavy floods in the Pakistan Rivers. There are two ways of dealing with this calamity. One is to provide sufficient water

way in each river to pass the heavy flood discharges safely. This would require clearing of the Khadir areas between the high banks of each river by dismantling all the paca structures including houses, villages and cities which have over grown in the Khadir areas. Certainly, this is not a practical solution. The other method is to let only that quantity of water in each river for which capacity is available in that river. The surplus water should be stored and subsequently used in a planned manner to meet the Agricultural, domestic, Industrial, Municipal and environmental requirements.

6. It is well known that soon after emergence of Pakistan, India stopped water in Ravi, Beas & Sutlej Rivers flowing down to Pakistan. This created a serious situation in the newly born Pakistan. However, this serious situation was resolved through the good offices of the World Bank and Indus Waters Treaty was signed with India in 1960. According to the provisions of this Treaty the waters of the three Eastern Rivers i.e. Ravi, Beas and Sutlej were allocated to India for its exclusive use. The waters of the three Western rivers i.e. Indus, Jhelum and Chenab were allocated to Pakistan. Pakistan was required to feed its canals off taking from Ravi, Beas and Sutlej rivers by constructing suitable replacement works. These works comprised two mega Dams at Tarbela and Mangla, six new Headwork and seven new Link canals. With the construction of these replacement works and the storages at Tarbela and Mangla the water uses as well as Agricultural production improved in Pakistan. The total average uses of 98 MAF in the pre-Treaty period were enhanced to 104 MAF in the post Treaty period. Pakistan was able to plan and operate its canal system according to the crop requirements. This increased the Agricultural production in Pakistan and the country became self-sufficient in food and fiber.

7. With the increase in population the demand of food and fiber increased tremendously. To meet this demand each piece of Agricultural land was sown with crops in the canal command areas. In Punjab the canal system is designed for a cropping intensity of 70% while the actual cropping intensity has now enhanced to 140 to 150%. The extra water to increase the irrigation intensity is being drawn by the farmers from ground water reservoir by installing tubewells. A study shows that presently about 1.2 million tubewells are installed in Punjab to meet the Agricultural targets. Operation of such a large number of tubewells is depleting the ground water level which has now depleted to the dangerous limits in certain areas. A study made in this respect indicates that the water being pumped from the ground reservoir in Punjab is to the extent of about 45 MAF annually. However, the recharge to the ground water is only about 43 MAF. Thus, there is a deficit of 2 MAF every year. This is not only causing further depletion of the ground water level but is also inducing creeping of saline water from the adjoining saline zones to the sweet water zone damaging the precious sweet water reservoir. In order to set right this situation, it is being planned under the National Water Policy to control ground water pumping. In view of growing population and increasing demand of food and fiber it may not be possible to control the ground water pumping. The only solution to control the ground water pumping is to increase the surface supply. This is only possible if new reservoirs are constructed.

8. It may be mentioned that WAPDA carried out an extensive study in 2002 captioned as Water Resources and Hydro Power Development Vision-2025. In this study WAPDA had identified the potential sites where mega, medium and small

reservoirs could be constructed to conserve river water as well as generate Hydroelectric Power to meet the Pakistan's energy requirements. Unfortunately, no significant progress has so far been made to implement this Programme.

9. For constructing new reservoirs some apprehensions have been expressed by certain stakeholders. This has blocked the process of constructing new reservoirs. It is time to discuss and resolve these apprehensions by the Water Experts and give priority to the construction of new reservoirs. IRSA which is the highest body to implement the Water Accord had also recommended in 2015 that the Federal Govt. should give top priority to construction of new reservoirs in order to meet the scarcity of water.

10. In WAPDA's aforesaid Development Plan certain mega reservoirs have been recommended to be constructed. The construction period of these reservoirs vary. The situation demands that those reservoirs which require minimum period of construction should be given priority over construction of the reservoirs which require longer time.

11. Apart from taking steps to enhance the quantum of water availability it is also necessary to plan and take immediate steps to conserve the existing availability. As a first step it is necessary to reduce the conveyance losses in the existing canal system. These losses are about 40% from the canal head to the farm gate. These conveyance losses should be reduced by lining all the canal systems i.e. main canals, branch canals, distributaries and minors. Even the water courses should also be lined.

12. In addition to above the current method of Irrigation in Pakistan also needs to be improved. Currently the method of flood Irrigation is adopted. It should gradually be converted into drip Irrigation, sprinkling Irrigation and other such methods which result in conservation of the existing availability.

13. Furthermore, it is considered essential that lower delta crops should be sown instead of higher delta crops. It is noticed that sowing of sugarcane is developing at the cost of cotton sowing. This has disturbed the present pattern of regulation in the canal system. It is, therefore, necessary that attention should be paid for devising suitable cropping pattern in the Country depending on the availability of canal water supply. Efforts should be made to cultivate lower delta crops instead of higher delta crops keeping in view the economy of the Country.

14. In the end it is concluded that key to development in Pakistan in all sectors depends on early construction of the mega reservoirs and conservation of the available supply by restoring to the economical methods of cultivation.

MID-TERM SYMPOSIUM ON THE THEME OF "WATER SCARCITY-STRATEGIC APPROACH"

Saturday, February 23, 2019



(From Left) Engr. Ch. Ghulam Hussain, Former President-PEC, Engr. Mehmud-ul-Hassan Siddiqui, Consultant Irrigation Department, the Chief Guest, Engr. Najam Waheed, Secretary-PEC



(From Left) Engr. Ch. Ghulam Hussain, Former President-PEC, Dr. Muhammad Abid Bodla, Engr. Najam Waheed, Secretary-PEC



(From Left) Engr. Ch. Ghulam Hussain, Former President-PEC Presenting Shield to The Chief Guest of Inaugural Session Engr. Mehmud-ul-Hassan Siddiqui



(From Left) Engr. Ch. Ghulam Hussain, Former President-PEC Presenting Shield to Dr. Muhammad Abid Bodla, Chairman First Technical Session



(From Left) Dr. Muhammad Abid Bodla and Engr. Ch. Ghulam Hussain, Former President-PEC presenting Shield to Engr. Abdul Qayyum for Presenting his Paper on the topic of **"CLIMATE CHANGE, SCARCITY OF WATER/ENERGY IN PAKISTAN AND SOLUTIONS THROUGH EDUCATION, CLEAN ENERGY, FLOODPLAINS / SEWERAGE REGULATIONS / MANAGEMENT"**



(From Right) Dr. Muhammad Abid Bodla and Engr. Ch. Ghulam Hussain, Former President-PEC presenting Shield to Mr. Ghulam Zakir Hassan Sial for Presenting his Paper on the topic of **"GROUNDWATER REGULATION FOR INTEGRATED WATER RESOURCES MANAGEMENT IN PUNJAB"**



(From Left) Dr. Muhammad Abid Bodla and Engr. Ch. Ghulam Hussain, Former President-PEC presenting Shield to Miss. Burera Khushbakht for Presenting her Paper on the topic of **"WATER CONTAMINATION AS A MAIN SOURCE OF WATER SCARCITY IN PAKISTAN"**

Questions/Answers Session



Engr. Ch. Mukhtar in conversation with the Speakers

Glimpses of the Audiences





Glimpses of the Audience






PAKISTAN ENGINEERING
CONGRESS

INTRODUCTORY REMARKS

By

ENGR. TARIQ RASHID WATTOO

PRESIDENT

PAKISTAN ENGINEERING CONGRESS

AT

THE WORLD WATER DAY ON SATURDAY, THE 30th MARCH 2019

ON THE THEME OF

"LEAVING NO ONE BEHIND"

Honorable Chief Guest, Prof. Dr. Hassan Amir Shah S.I.

Distinguished Participants,

Members of Pakistan Engineering Congress,

Fellow Engineers, Ladies and Gentlemen!

Assalam-o-Alaikum

World Water Day is commemorated every year during the month of March based on a universally adopted theme. Pakistan Engineering Congress is actively involved in this process and is celebrating the World Water Day regularly since 2005. The papers presented in this moot from the Congress forum are formally documented and distributed complimentarily to Members of the Congress, Concerned Federal/Provincial Government Departments, Technical Institutions, Libraries and Educationists in pursuit of its cardinal objective of disseminating information and knowledge.

The Pakistan Engineering Congress, established in year 1912, incidentally the same year when American Society of Civil Engineers was founded, is the oldest Engineering body of the Sub-Continent. Major objectives of the Congress are propagation and promotion of engineering knowledge and practices for the advancement of the engineering profession. Selected technical papers of the highest standards, on different subjects of national and global importance, are presented and discussed during its annual sessions and on various other occasions. Symposia on important engineering problems are also held during the Annual and the Mid-term sessions and the resulting recommendations are sent to the concerned quarters of the Government for consideration.

A large number of papers presented at the Congress platform have won world-wide recognition and acclaim. Many advances, such as Kennedy, Lacy, and Khosla theories, made in the fields of various engineering disciplines, were first presented and discussed at the platform of this Congress. Over the past 100 years

presentation and publication of 791 technical papers have been managed by the Congress. Annual publications of the Congress constitute a valuable treasure of engineering knowledge. These papers have been uploaded on the Congress Website and are being intercepted by thousands of engineers and researchers all over the world. The Congress regularly observes the "World Water Day" and "World Environment Day" where presentations are made to create awareness amongst the masses about the vital resources and their conservation.

Ladies and Gentlemen!

Universal theme for this year is **Leaving No One Behind.** This is very much linked to UN's Sustainable Development Goal (SDG) Number-6, **"*To Ensure Availability and Sustainable Development of Water for all by 2030".*** Considering the objective of this goal, the issue of water availability, particularly for human consumption has come in the forefront.

Therefore, in the context of Pakistan ground realities and 2030 horizon of SDG focus should be on the following related measures:

- Encouraging integrated water resource development and management.
- Water Conservation through storages and revamping of conveyance infrastructure
- Provision of grass-root level drinking water supplies sewerage and sanitation facilities.
- Treatment of injurious sewage effluent to avoid quality deterioration of natural surface / sub-surface water bodies with added benefit of reuse for agriculture.
- Prevention of Environmental/ecclesial degradation through Sustainable Development
- Provision of Technical Education curricula with focus on water resource development and management
- Public awareness campaigning regarding real values of water and need for its conservation in the face of impending acute scarcity

Ladies and Gentlemen!

Due to short sightedness of policy decision makers and lack of holistic planning, Pakistan is now faced with the following grave water related problems;

- It is already one of high water stressed countries on the basis of per capita water availability and by 2030 may graduate to extremely high water stressed category
- It is one of the most vulnerable countries to climate changes with major impact on water resources
- Surface water regulation capability is dwindling due to rapid sedimentation of on-line storages and construction of no major project over the last 42 years

- Excessive groundwater mining due to uncontrolled pumping through 1-million tubewells
- Ticking population explosion bomb and if not effectively controlled with present population of over 220 million and projected to touch 300 million by 2030 if the current annual growth rate of 2.4% is not controlled

Ladies and Gentlemen!

In the present scenario, following pipe line projects planned to be completed before 2030 could contribute towards national efforts of "Leaving no one Behind" in pursuance of the relevant SDG No.6

- Multipurpose storages of Mohmand Dam, Kurram Tangi Dam and Diamer Basha Dam with aggregate live storage of about 7.5 MAF and installed hydropower capacity of about 5300 MW.
- Single purpose small storages of Naulong Dam, Gaj Nai Dam and Chiniot Dam.

Recently, the Government has taken following initiatives which may have a significant Contribution towards achieving the goal of "Leaving No One Behind";

- **Naya Pakistan Housing Project** for construction of about 5 million low cost homes.
- Launching of Anti-Poverty initiative **"Ehsas"** by the Prime Minister of Pakistan with initial allocation of Rs.80 Billion and its further raising to Rs.120 Billion by 2021.
- Some recent initiative by Government of Punjab for water conservation by domestic / industrial consumers in Mega cities like Lahore.

Ladies and Gentlemen!

In this moot today, 11 papers are being presented by competent professional, related to the various aspects of the theme. It is hoped that these presentations topped by concluding remarks by the Chief Guest will be thought provoking for contributing our part in pursuit of the theme of this World Water Day.

Thanking you all for participating in this event.

PAKISTAN PAINDABAD

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WORLD WATER DAY

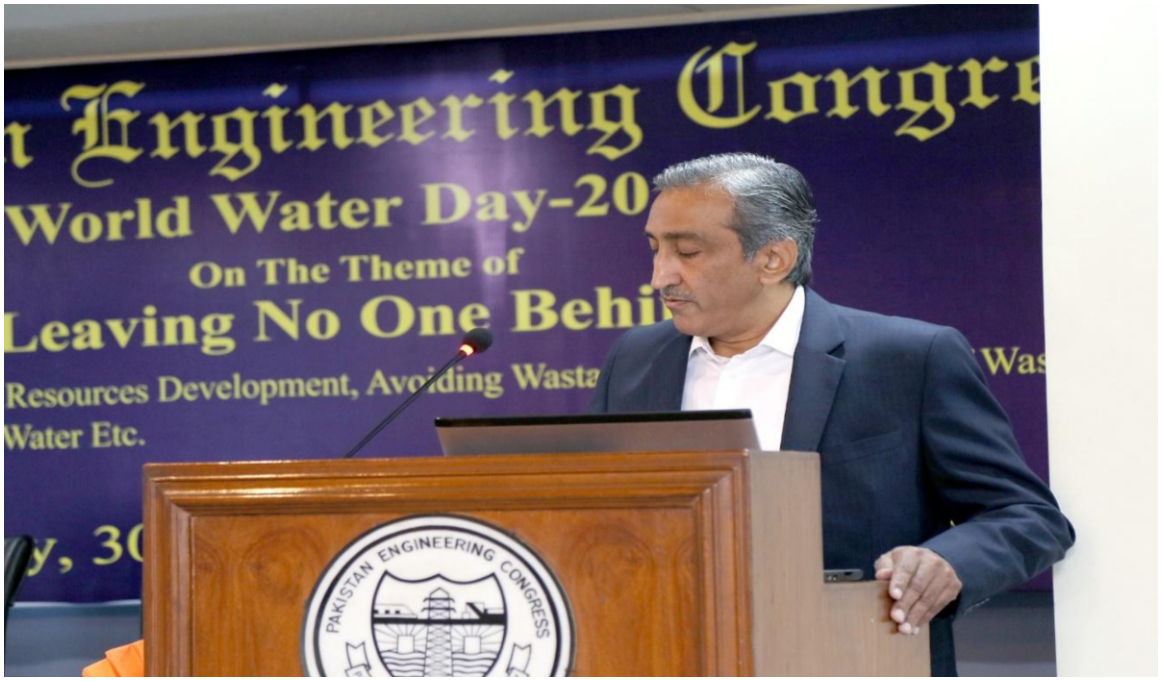
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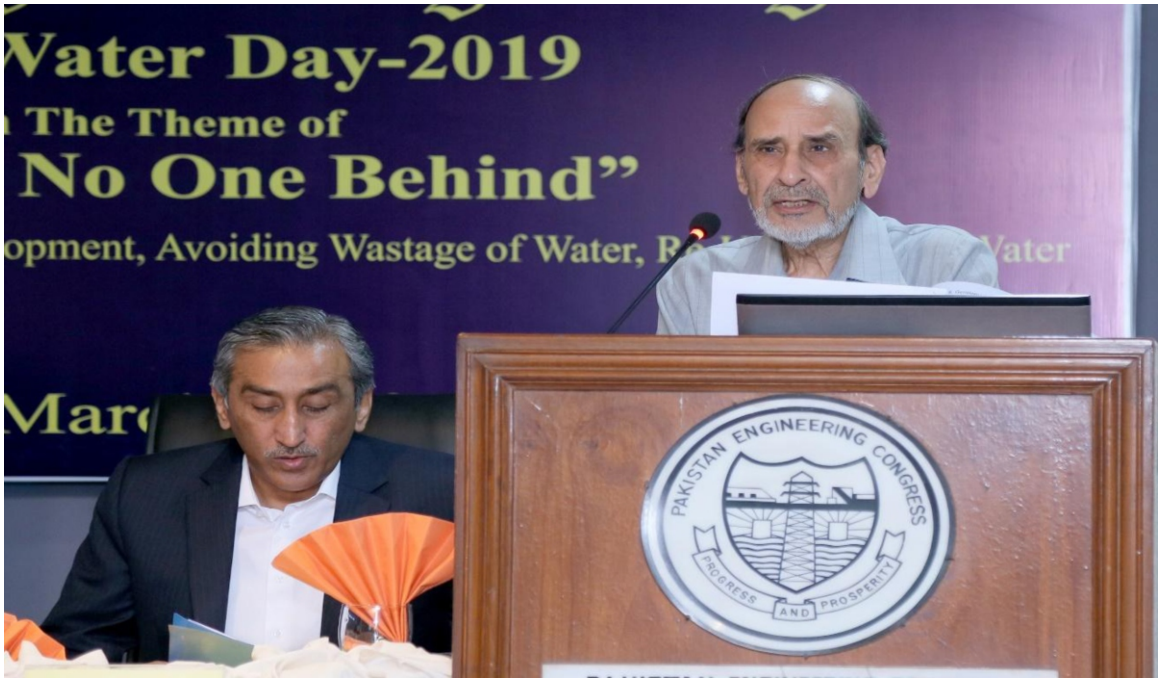
Saturday, March 30, 2019



(From Left) Engr. Ch. Ghulam Hussain, Former President-PEC, Prof. Dr. Hassan Amir Shah, S.I, Vice-Chancellor, Govt. College University, the Chief Guest, Engr. Najam Waheed, Secretary-PEC



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



Engr. Ch. Ghulam Hussain, Former President-PEC presenting the Welcome Address



The Chief Guest, Prof. Dr. Hassan Amir Shah, S.I, Vice Chancellor, Govt. College University delivering the Concluding Remarks at the end of the Lecture at the event



(From Right) Engr. Ch. Ghulam Hussain, Former President-PEC Presenting Shield to The Chief Guest Prof. Dr. Hassan Amir Shah, S.I, Vice Chancellor, Govt. College University



(From Right) Prof. Dr. Hassan Amir Shah, S.I and Engr. Ch. Ghulam Hussain Presenting Shield to Dr. Muhammad Saeed for presenting his paper on the topic of "STUDY QUANTUM OF TRANSBOUNDARY GROUNDWATER FLOW FROM INDIA TO PAKISTAN"



(From Right) Prof. Dr. Hassan Amir Shah, S.I and Engr. Ch. Ghulam Hussain Presenting Shield to Dr. Allah Bukhsh Sufi for presenting his paper on the topic of "NATURAL BASED SOLUTIONS TO WATER CHALLENGES"



(From Right) Prof. Dr. Hassan Amir Shah, S.I and Engr. Ch. Ghulam Hussain Presenting Shield to Engr. Zamir Ahmed Soomro for presenting his paper on the topic of "WATER SAVING POTENTIAL IN RICE CROP USING BED PLANTATION TECHNIQUE"



(From Right) Prof. Dr. Hassan Amir Shah, S.I, Presenting Shield to Mr. Faiz Raza Hassan for presenting his paper on the topic of "IMPLICATIONS OF GROUNDWATER EXPLOITATION FOR FUTURE GENERATION"



(From Right) Prof. Dr. Hassan Amir Shah, S.I, Presenting Shield to Miss. Kanza Naseer for presenting his paper on the topic of "NUTRIENT REMOVAL EFFICIENCY OF CONSTRUCTED WETLAND FOR WASTEWATER TREATMENT AND REUSE"



(From Right) Prof. Dr. Hassan Amir Shah, S.I, Presenting Shield to Miss. Nimra Fayyaz for presenting his paper on the topic of “LEACHATE POTENTIAL TO CONTAMINATE THE GROUNDWATER IN THE VICINITY OF LANDFILL SITES”



(From Right) Prof. Dr. Hassan Amir Shah, S.I, Presenting Shield to Engr. Abdul Qayyum for presenting his paper on the topic of “NEED OF PROPER NATIONAL-ACTION-PLAN UNDER APPROPRIATE LEGISLATION/ REGULATIONS/ TECHNOLOGIES/ FUNDING TO ACHIEVE PAKISTAN’S SUSTAINABLE DEVELOPMENT GOALS SPECIFICALLY GOAL 6 AND ITS TARGET 6.3”



(From Right) Prof. Dr. Hassan Amir Shah, S.I, and Engr. Ch. Ghulam Hussain Presenting Shield to Mr. Hamza Bin Riaz for presenting his paper on the topic of "Water Quality Assessment of Rawal Dam with Special Consideration to Chattar, Murree stream"

Glimpses of the Audiences



Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Group Photos



Group Photo of the Authors of the Papers with the Chief Guest Prof. Dr. Hassan Amir Shah S.I. Vice Chancellor Govt College University



Another Group Photo of Authors, Students etc. with the Chief Guest Prof. Dr. Hassan Amir Shah Vice Chancellor Govt. College University.

Scholarship Program of Pakistan Engineering Congress:

The Scholarship Program of the Congress is unique in the sense that every year approximately 200-Scholarships are awarded for Graduate Engineering Studies for full span of 4-Years and MS Engineering Studies for full span of 2-Years of Rs.4,000 and Rs. 6,000 per month respectively. Over the years the Congress has awarded 944 Scholarships to the Public & Private sector Engineering Universities and have disbursed over Rs 70-Million.

At present following Scholarships are in operation

Graduate Engineering Studies

200 Scholarships of Rs. 4000/P.M are in operation.

M.S Engineering Studies

232 Scholarships of Rs. 6000/P.M are in operation.

Distribution of Scholarship Cheques

In addition to the 42-Scholarships Cheques of Rs. 15.12 Lac and further cheques of Rs. 2.88 Lac were given by Engr. Iftikhar Ahmed Former President/Convener Welfare of Engineers Committee on March 30, 2019.

Distribution of Scholarship Cheques



Distribution of Scholarship Cheques




World Water Day-2019
On The Theme of
"Leaving No One Behir
Water Conservation, Water Resources Development, Avoiding Wastage
Clean Surface and Ground Water Etc.


Water Conservation, Water Resources Development, Avoiding Wast
Clean Surface and Ground Water
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TECHNICAL VISIT TO CHAKWAL PLANT OF BESTWAY CEMENT LTD. AND KATAS RAJ MANDAR 16TH FEBRUARY 2019

Pakistan produces high quality port land Cement. At the time of inception there were only 4-cement plants in Pakistan with an annual capacity of 3-Lac metric tons. Due to infrastructure development, the construction and expansion of Roads Khunjrab, Gawadar Highway 2400 KM, Karachi Lahore Motorway 1060 KM, Rails, Ports, Gawadar Ports, and CPEC projects there has been huge expansion in the industry and the number of cement plants has risen from 4-units to 29-units and with it the production of cement has risen from 0.3 million to 49 million metric tons. It is expected to increase to 75 million metric tons by 2020.

In this connection a 14- Members Strong Delegation led by Engr. Capt.(R) M. Qadir Khan Joint Secretary and Engr. M. Anwar Qaseem Qureshi Member Executive Council Visited Bestway Cement Ltd. Chakwal Cement Plant on 14-2-2019.

The delegation was given warm welcome on arrival at the plant, were given extensive briefing on the project and explained the operational working in manufacturing of cement followed by a visit to administrative and manufacturing departments. At the conclusion of the visit Engr. Capt.(R) M. Qadir Khan Joint Secretary Presented the congress Shield and its publications to Engr. Aftab Ahmad, Manager Production.

After the visit to the cement plant the delegation traveled to the historical Katas Raj Mandar which has also been in news recently. It was an interesting visit.



The Delegation is being given detailed briefing about the Chakwal Cement Plant (Participation for Safety Briefing)



The Delegation is being given detailed briefing about the Chakwal Cement Plant



Engr. Capt. (R) M. Qadir Khan (Joint Secretary PEC) Presenting Shield to Engr. Aftab Ahmad (Manager Production Bestway Cement Ltd).



Engr. Capt. (R) M. Qadir Khan (Joint Secretary PEC) Presenting Pakistan Engineering Congress Publications to Engr. Aftab Ahmad (Manager Production Bestway Cement Ltd).



(Standing) Engr. Aurangzaib, Engr. Mubashar Bajwa, Engr. M.A. Qaseem Qureshi (Publicity Secretary PEC), Engr. Hafiz Arslan Rehman, Engr. Zulfiqar Ali, Engr. Capt. (R) M. Qadir Khan (Joint Secretary PEC), Mr. Tanveer Hussain, Engr. Mubeen Shahid, Engr. Umair Maqbool, Engr. Muhammad Waqas. (Information about Control Room)



View of Katas Raj Mandars. Shive Mandar, Shadi Mandap, Hanoman Mandar, Ram Mandar, Ganesh Mandar



(Group Photo) Engr. Mubashar Bajwa, Engr. Salman Awan, Engr. Zulfiqar Ali, Engr. Hafiz Arslan Rehman, Engr. Capt. (R) M. Qadir Khan (Joint Secretary PEC), Engr. Mubeen Shahid, Engr. M. A. Qaseem Qureshi (Publicity Secretary PEC), Engr. Umar Hayyat, Engr. Muhammad Farhan Wali. (On the Front of Ashnan Ghat)

TECHNICAL VISIT OF THE DELEGATION OF PAKISTAN ENGINEERING CONGRESS TO THE PLANT OF FAST CABLES LTD. RAIWIND LAHORE ON 13-4-2019

A strong Delegation of Pakistan Engineering Congress comprising 14-Members of the Congress lead by Engr. Iftikhar Ahmad Former President-PEC and Engr. Najam Waheed Secretary-PEC visited Fast Cables Raiwind Road Lahore on 13-4-2019.

Fast Cables has been engaged in manufacturing electrical cables and Conductors for over 30 years and ever since its inception, the organization has emerged as Pakistan's most trusted and leading cables manufacturers. Fast Cables' products are manufactured according to BS/IEC standards and are duly certified by leading certification agencies at National and International level. Production setups are compliant with ISO 9001, ISO 18001 besides being CE Certified.

The new plant is the largest production facility in Pakistan as of now and caters to demands and requirements of cables upto 36KV which were not being manufactures in Pakistan before this.

The delegation was extensively briefed by the Executives of the Company and was taken round of their various departments i.e. Business Development Department, Quality lab, Quality Department and were given demonstration of high-end Technology. It was a very fruitful visit.

The Visit was capped by the Presentation of the Congress Publications to Engr. Adeel Raheel Head Business Development of the Company.

TECHNICAL VISIT OF PEC TO FAST CABLES



Figure 1- Fast Cables Head of Business Development Department Engr. Adeel Raheel Welcoming address PEC Participants at State-of-the-Art Manufacturing Facility Near Sundar Industrial Estate.



Figure 2- (From Right) Engr. Najam Waheed, Secretary-PEC, Engr. Ch. Iftikhar Ahmad, Former President-PEC and Engr. Muhammad Amjad S.E. C&W



Figure 2- Engr. Iftikhar Ahmad, Former President-PEC, Engr. Najam Waheed, Secretary-Pec and Engr. Dr. Muhammad Saeed, Member Executive Council presenting Congress Publications to Engr. Adeel Raheel of M/s. Fast Cables Ltd.



Figure 3- PEC Member sharing his experience of Quality Cables



Figure 4- QC Engr. Usman Hussain Demonstrating DCR Meter Functioning



Figure 5- Group Photo of PEC Members with Mian Ghulam Murtaza Shaukat Chief Executive of Fast Cables

IDB, WAPDA DISCUSS SUPPORT FOR HYDROPOWER DEVELOPMENT PROGRAMME IDB PRESIDENT PRAISES NEELUM JHELUM SUCCESS, VOWS TO CONTINUE SUPPORT FOR WAPDA PROJECTS

May 03, 2019: A 6-member delegation of the Islamic Development Bank (IDB), headed by its President Dr. Bandar M. H. Hajjar currently on a visit to Pakistan, today called on Pakistan Water and Power Development Authority (WAPDA) Chairman Lt Gen Muzammil Hussain (Retd) to discuss potential support for development of a programme to facilitate construction of hydropower projects in Pakistan.

Speaking on the occasion, WAPDA Chairman appreciated IDB for providing financial assistance to complete various WAPDA projects in hydropower sectors. “IDB and WAPDA has longstanding relationship of mutual cooperation, and I am confident this cooperation will further strengthen for upcoming WAPDA projects”, he added. The Chairman said that WAPDA holds a strong asset base, therefore, enjoys trust of national and international financial institutions for arrangement of funds for its projects. WAPDA hydropower projects provide excellent investment opportunities and like other institutions, IDB can also make benefit of the opportunities for investing in these projects. He also briefed the delegation about the upcoming WAPDA projects including Mohmand Dam, Diamer Basha Dam and Keyal Khwar.

The IDB President, showing keen interest in financing hydropower projects, thanked WAPDA for arranging such a useful briefing for them. He also congratulated WAPDA on the recent landmark of Neelum Jhelum Hydropower Project to generate 1040 MW - successful operation of the project at 108% beyond its installed capacity of 969 MW. He said that IDB feels honoured to be a leading partner in development of this engineering marvel.

It is worth mentioning that the IDB provided US $ 357.6 million for construction of 969 MW-Neelum Jhelum Hydropower Project. In addition, it had also provided financial assistance to the tune of US $ 150.2 million for three high head hydropower projects namely Khan Khwar, Duber Khwar and Allai Khwar with cumulative generation capacity of 323 MW.

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PAKISTAN'S ONLY DEEP-WATER PORT ENTERS PHASE II OF EXPANSION

O SALMAN SIDDIQUI

KARACHI

Hutchison Ports Pakistan will double installed capacity to 3.4m TEUs by end 2020



Hutchison Ports Pakistan, the country's first and only deep-water port capable of berthing the world's largest container vessel, has entered into its second phase of expansion.

"The expansion will enhance the installed capacity to handle 3.4 million containers of 20-foot length each by the end of 2020 compared to 1.5 million TEUs {twenty-foot equivalent units) at present," General Manager and Head of Business Unit Captain Syed Rashid Jamil said while briefing a group of journalists at the expansion site on Monday.

A four-lane railway cargo track of around 4-5 kilometres inside the port facility, coupled with an increase in installed capacity of power production are also included in the second phase expansion plan.

The deep-water port is located at the Karachi Port Trust (KPT). It is a subsidiary of Hutchison Port Holdings of Hong Kong which enjoys 90% shareholding. KPT is a

partner in the project. Some local transport and logistics firms have the rest 10% shareholding in the port. The port began commercial operations in February 2017.

Total cost of the project is $4 billion, which includes KPT's share of $800 million and Hutchison Ports Pakistan's (HPP) contribution over $600 million.

So far, HPP has spent $450-500 million. "Estimates suggest that it would be spending close to $750-800 million by the time the second phase gets completed," stated reliable sources.

The firm has opted for expansion despite the growth rate of cross-border transportation of the containerised cargo remaining flat at around 3.4 million TEUs in calendar year 2018 and it shrank 5% in the first four months (January-April) of the current year.

"We are expanding containerised cargo handling capacity as per our original plans of 2007 when we signed and initiated the project on built, maintain and transfer basis," Jamil added.

The port is capable of berthing the world's largest container vessel of 25,000 TEUs as it has a depth of 18 metres at the outer approach channel and 16.5 metres on the berth side. So far, it received the largest ever container ship of 11,923 TEUs - the China India Express - in December 2018.

Earlier, Pakistan was unable to handle containerised vessels of more than 8,000 TEUs.

The reliable sources noted that growth in the cross-border transportation of containerised cargo shrank in the current year after the incumbent government imposed conditions on fast moving consumers goods (FMCCs) sector including printing details and ingredients, halal certificate and expiry date on the products packaging. The deep-water port has a 28-megawatts (MW) diesel-based captive power plant. It would increase the power production capacity by 8MW in the second phase.

China, the single largest trading partner of Pakistan, has remained the biggest source of containerised cargo transportation at the deep-water port. Besides, it also transports import and export containerised cargo to and from Europe and the US.

‘AFFORESTATION IN THE CITY OF GARDENS’ IS A COMMITMENT TO A GREENER PAKISTAN

It is heart-warming to note that Lahore has finally decided to live up to its title of ‘The City of Gardens’ and give greenery a chance. Project titled ‘Afforestation in the City of Gardens’ is a result of the partnership between the Commissioner Office Lahore and the Lahore Biennale Foundation (LBF) who have brought the civil society together for this.

“So the Commissioner’s Office, Lahore and the LBF began this afforestation drive where the idea was to move away from beautification with a manicured look using imported plants towards wilder dense forests using indigenous trees. This is critical at a time when Lahore has lost 75 percent of its tree cover in the last 10 years. I work with the Lahore Conservation Society/Lahore Bachao Tehrik which is actively working on this project as the technical partner in this consortium of the government and civil society”.

The project aims to convert at least 10 percent of the land in Lahore into tree cover, planting approximately 8,311,689 trees. The initial phase of the project is spread across spring and monsoon seasons. During the spring season pilot projects and sites will be undertaken while the monsoon season will include the extension of invitation to other cities for region wide plantation drive.

“We have been given land in several areas across Lahore from various government departments including PHA, railways, NHA etc and are working on parks in Johar Town, Sabzazar, Ring Road, Mian Mir Colony, etc,” Attiya Noon says.

There are multiple benefits to a government-civil society partnership. While the government is able to provide the mass mobilisation and institutional knowledge, the civil society brings in the aesthetic and field expertise necessary for the efficient execution of the project. It is hoped that this project will serve as a blueprint for future, similar projects that can be replicated by other cities of the country.

“We have had inaugural plantation drives already on the canal heritage park, a park in Johar Town that neighbours a school for special needs children. Next week we will be planting in nursery ground in main market with the World Wide Fund as a partner as well as on the Ring Road with go green as a partner who has brought in Descon as a sponsor on this Ring Road site,” Noon says.

Over the next few months, the project will draft a manifesto followed by an invitation to other cities of Pakistan to join hands in this endeavour. This will be followed by inviting other countries of the region to join in by Spring 2020 in order to create a wider network.

“The idea is to ensure all Lahoris understand the importance of this project and take ownership of it,” she said.

In terms of project outreach, all citizens of Lahore will be invited to contribute with their creative visions, donating plants, creating nurseries. With this, it is hoped that these individuals design spaces keeping in mind Lahore as the City of Gardens, its

history while also granting them greater ownership of the city. Lahore is widely referred to as the “City of Gardens” and along with rich cultural history; it is home to many gardens that form part of its identity which the project hopes to revive. Afforestation activities will include sowing of selective indigenous species of plants.

“One of the most challenging things about this project is, ironically, the supply of indigenous saplings which are in short supply due to the country drive. We have an urgent and great need for nurseries to meet this demand in the years to come,” she maintained.

While a majority of the sites granted by the Lahore Administration and Commissioner Office are large, sprawling urban centres along highways or open parks, this initiative will not ignore the vital role played by smaller parks in Lahore.

Some of the names of the trees being planted are Acacia Nilotica, Bauhinia Alba, Callestemon Viminalis, Dilbergia Sisso, Ficus Religiosa, Jacaranda, Olifolia, Melia Adadrach, Pinus Roxburghi, Milletia Pinnata, Sappindus Mukaroosi, Tamarind and Zizyphus Mauratania.

Published in Daily Times dated 28-4-2019

PAKISTAN DOESN'T NEED ADDITIONAL TAXES TO COVER REVENUE SHORTFALL: WB

By

Arnin Ahmed

ISLAMABAD: Pakistan has substantial potential to increase tax receipts without imposing new taxes or increasing their rates. The country's tax revenue potential would reach 26 per cent of GDP, if tax compliance were to be raised to 75 per cent, which is a realistic level of compliance for lower middle income countries. This means that Pakistan's tax authorities are currently capturing only half of this revenue potential — the gap between actual and potential receipts is 50 per cent, according to a new document prepared by the World Bank titled Pakistan Revenue Mobilisation Project, published recently.

This comes against the backdrop of revenue shortfall which the government has sought to diminish with the Washington-based lender's assistance of $400 million for the revenue mobilisation project to be implemented by the Federal Board of Revenue (FBR) aiming to contribute to a sustainable increase in domestic revenue by broadening the tax base and facilitating compliance. The credit of $400m will come from World Bank affiliate, International Development Association (IDA).

However, the FBR has internal challenges which it needs to overcome as it has a negative impact on tax receipts. According to the project document, unlike most revenue authorities in the world, the FBR is not organised along functional lines, nor does it have a clear hierarchical structure. FBR is a large organisation with a nationwide presence and more than 21,000 staff, of whom about two thirds work for the Inland Revenue Service (IRS) and one third for the Pakistan Customs.

Also, lack of coordination between the federal and provincial governments has a negative impact on total tax receipts, as well as complicating taxpayer compliance. The different rules applied by the federation and the provinces generate frequent disputes, especially over input adjustments for GST taxpayers.

The document says that Pakistan needs to increase its tax revenues to ensure fiscal sustainability and generate fiscal space to finance much needed investments in human capital and infrastructure.

The project document also highlights the share of tax revenue collected by the provinces remains small at nine per cent of total receipts but has been growing rapidly, from 0.4 per cent of GDP in 2010-11 to 1.2 per cent in 2017-18. Despite this progress, tax receipts still fall short of 15 per cent of GDP, which is the minimum that international experts consider adequate to cover the basic expenditure needs of developing countries, it says.

Nevertheless, the country's revenue performance has improved significantly in recent years, rising from 9.5 per cent of GDP in 2011-13 to 13 per cent in 2017-18. This increase in tax revenues has resulted from tax policy measures, notably reduction in tax exemptions for specific industries, and improvements in tax administration at the federal and provincial levels.

Transformation roadmap

The current government is quite keen to increase tax revenues and improve performance of the FBR which has, according to the policy document, developed a transformation roadmap which envisions that the FBR would become a semi-autonomous revenue authority with financial, managerial and operational autonomy.

This would involve a degree of financial and managerial autonomy from the regular controls and procedures of the federal government.

Key changes would include security of tenure for the FBR chairman for a fixed mandate, a financing formula whereby the FBR's budget would be fixed as a share of previous year's receipts — one per cent and flexibility to use its budget across budget lines as needed.

The proposed project will support the implementation of the FBR's road-map over the next five years. The roadmap consists of three parts: a ten-year vision for the FBR's institutional transformation, three-year dynamic implementation plan (1920-22) to be updated annually and short-term action plan for accelerating revenue collection in 2019.

The roadmap also highlights measures to strengthen the technical expertise and improve the performance of the FBR's human resources. Technical expertise will be strengthened by establishing technical streams for core tax administration functions for career FBR officials and by externally hiring specialised staff for procurement, human resources, and communications.

The project will support key initiatives and targeted results under the FBR's transformation roadmap. The project's interventions therefore focus on equipping the FBR with the needed ICT tools and technical skills to make effective use of taxpayer information using big data techniques and modern risk-based tools for more efficient, targeted compliance control and enforcement.

FBR has already launched several initiatives under the roadmap including new payment options for taxpayers and ongoing review of tax laws and regulations to simplify and make them more accessible to taxpayers.

Published in Dawn of 6-5-2019

WINNING THE WAR ON POVERTY

According to recently released data, between 2015 and 2017, Canada reduced its official poverty rate by at least 20 percent. Roughly 825,000 Canadians were lifted out of poverty in those years, giving the country today its lowest poverty rate in history.

How did it do it?

The overall economy has been decent but not robust enough to explain these striking outcomes. Instead, one major factor is that Canadians have organized their communities differently. They adopted a specific methodology to fight poverty.

Before I describe this methodology, let's pause to think about what it's often like in American poor areas. Everything is fragmented. There are usually a bevy of public and private programs doing their own thing. In a town there may be four food pantries, which don't really know one another well. The people working in these programs have their heads down, because it's exhausting enough just to do their own work.

A common model is one-donor-funding-one-program. Different programs compete for funds. They justify their existence using randomized controlled experiments, in which researchers try to pinpoint *one* input that led to *one* positive output. The foundation heads, city officials and social entrepreneurs go to a bunch of conferences, but these conferences don't have much to do with one another.

In other words, the Americans who talk about community don't have a community of their own. Every day, they give away the power they could have if they did mutually reinforcing work together to change whole systems.

In Canada it's not like that. About 15 years ago, a disparate group of Canadians realized that a problem as complex as poverty can be addressed only through a multisector comprehensive approach. They realized that poverty was not going to be reduced by some innovation — some cool, new program nobody thought of before. It was going to be addressed through better systems that were mutually supporting and able to enact change on a population level.

So they began building citywide and communitywide structures. They started 15 years ago with just six cities, but now they have 72 regional networks covering 344 towns.

They begin by gathering, say, 100 people from a single community. A quarter have lived with poverty; the rest are from business, nonprofits and government.

They spend a year learning about poverty in their area, talking with the community. They launch a different kind of conversation. First, they don't want better poor; they want fewer poor. That is to say, their focus is not on how do we give poor people food so they don't starve. It is how do we move people out of poverty. Second, they up their ambitions. How do we *eradicate* poverty altogether? Third, they broaden

their vision. What does a vibrant community look like in which everybody's basic needs are met.

After a year they come up with a town plan. Each town's poverty is different. Each town's assets are different. So each town's plan is different.

The town plans feature a lot of collaborative activity. A food pantry might turn itself into a job training center by allowing the people who are fed do the actual work. The pantry might connect with local businesses that change their hiring practices so that high school degrees are not required. Businesses might pledge to raise their minimum wage.

The plans involve a lot of policy changes on the town and provincial levels — improved day care, redesigned transit systems, better work-force development systems.

By the time Canada's national government swung into action, the whole country had a base of knowledge and experience. The people in the field had a wealth of connections and a sense of what needed to be done. The two biggest changes were efforts in city after city to raise the minimum wage and the expansion of a national child benefit, which can net a family up to nearly $6,500 a year per child. Canada essentially has guaranteed income for the young and the old.

The process of learning and planning and adapting never ends. The Tamarack Institute, which pioneered a lot of this work, serves as a learning community hub for all the different regional networks.

Paul Born, the head of the institute, emphasizes that the crucial thing these communitywide collective impact structures do is change attitudes. In the beginning it's as if everybody is swimming in polluted water. People are sluggish, fearful, isolated, looking out only for themselves. But when people start working together across sectors around a common agenda, it's like cleaning the water. Communities realize they can do more for the poor. The poor realize they can do more for themselves. New power has been created, a new sense of agency.

Born doesn't think you can really do social change without a methodology, without creating community-wide collective impact structures. But in many American communities we're mostly scatter shot. That's the problem with our distrust and polarization. We often don't build structures across difference. Transformational change rarely gets done.

IN ASTROPHYSICS MILESTONE, FIRST PHOTO OF BLACK HOLE EXPECTED



Scientists are expected to unveil on Wednesday the first-ever photograph of a black hole, a breakthrough in astrophysics providing insight into celestial monsters with gravitational fields so intense no matter or light can escape.

The U.S. National Science Foundation has scheduled a news conference in Washington to announce a "groundbreaking result from the Event Horizon Telescope (EHT) project," an international partnership formed in 2012 to try to directly observe the immediate environment of a black hole.

Simultaneous news conferences are scheduled in Brussels, Santiago, Shanghai, Taipei and Tokyo.

A black hole's event horizon, one of the most violent places in the universe, is the point of no return beyond which anything – stars, planets, gas, dust, all forms of electromagnetic radiation including light – gets sucked in irretrievably.

While scientists involved in the research declined to disclose the findings ahead of the formal announcement, they are clear about their goals.

> "It's a visionary project to take the first photograph of a black hole. We are a collaboration of over 200 people internationally," astrophysicist Sheperd Doeleman, Director of the Event Horizon Telescope at the Center for Astrophysics, Harvard & Smithsonian, said at a March event in Texas.

The news conference is scheduled for 9 a.m. (1300 GMT) on Wednesday.

The research will put to the test a scientific pillar – physicist Albert Einstein's theory of general relativity, according to University of Arizona astrophysicist Dimitrios Psaltis, project scientist for the Event Horizon Telescope. That theory, put forward in

1915, was intended to explain the laws of gravity and their relation to other natural forces.

Supermassive Black Holes

The researchers targeted two supermassive black holes.

The first – called Sagittarius A* – is situated at the center of our own Milky Way galaxy, possessing 4 million times the mass of our sun and located 26,000 light years from Earth. A light year is the distance light travels in a year, 5.9 trillion miles (9.5 trillion km).

The second – called M87 – resides at the center of the neighboring Virgo A galaxy, boasting a mass 3.5 billion times that of the sun and located 54 million light-years away from Earth. Streaming away from M87 at nearly the speed of light is a humongous jet of subatomic particles.

Black holes, coming in a variety of sizes, are extraordinarily dense entities formed when very massive stars collapse at the end of their life cycle. Supermassive black holes are the largest kind, devouring matter and radiation and perhaps merging with other black holes.

Psaltis described a black hole as “an extreme warp in spacetime,” a term referring to the three dimensions of space and the one dimension of time joined into a single four-dimensional continuum.

Doeleman said the project’s researchers obtained the first data in April 2017 from a global network of telescopes. The telescopes that collected that initial data are located in the U.S. states of Arizona and Hawaii as well as Mexico, Chile, Spain and Antarctica. Since then, telescopes in France and Greenland have been added to the network.

The scientists also will be trying to detect for the first time the dynamics near the black hole as matter orbits at near light speeds before being swallowed into oblivion.

The fact that black holes do not allow light to escape makes viewing them difficult. The scientists will be looking for a ring of light – radiation and matter circling at tremendous speed at the edge of the event horizon – around a region of darkness representing the actual black hole. This is known as the black hole’s shadow or silhouette.

Einstein’s theory, if correct, should allow for an extremely accurate prediction of the size and shape of a black hole.

> “The shape of the shadow will be almost a perfect circle in Einstein’s theory,” Psaltis said. “If we find it to be different than what the theory predicts, then we go back to square one and we say, ‘Clearly, something is not exactly right.’”

WORLD WATER DAY ON MARCH 22
WAPDA PLANS TO ADD 10 MAF WATER STORAGE BY 2030

March 21, 2019: As the comity of nations is all set to celebrate 'World Water Day' on March 22 to create awareness about conservation and prudent use of water, the Pakistan Water and Power Development Authority (WAPDA) has been expeditiously working on a number of projects to improve water situation in order to avert looming water crisis in the country. For optimal utilization of water resources, WAPDA has devised a comprehensive strategy, through which various projects will be completed in a phased manner under short, medium and long term plans.

WAPDA plans to add two million acre feet (MAF) to water storage capacity up to 2025 in short term, another eight MAF up to 2030 in medium term and 28 MAF up to 2050 in long term with completion of its projects. The construction work on Mohmand Dam is about to start in couple of weeks, while construction of Diamer Basha Dam will also commence this year.

According to the details, the water storage projects to be completed by 2025 under short term plan include Mohmand Dam, Nai Gaj Dam, Naulong Dam and Kurram Tangi Dam (Stage-I). Diamer Basha Dam, Kurram Tangi Dam (Sage-II), Chiniot Dam, Bara Dam and Hingol Dam are a few to be implemented by 2030 under medium term plan. Shyok Dam, Skardu Dam, Akhori Dam and Rohtas Dam are among the projects which are planned to be completed by 2050 under long term plan. Prompt decision making by all the stakeholders and timely availability of funds are key to implementing short, medium and long term projects in accordance with their timelines.

It is pertinent to mention that water situation in Pakistan is alarming by any standards because of the varied reasons, hence, needs to be improved through effective water management and construction of dams. The per capita water availability
in Pakistan has gone down from 5260 cubic meter in 1951 to an alarming level of 908 cubic meters per annum due to rapid growth in population and depleting water storage capacity of the reservoirs because of the natural phenomenon of sedimentation. The per capita availability of water has pushed Pakistan to the stage of water-scarce country and if nothing is done, we will become a water starved country. Pakistan can store only 10 per cent of its annual river flows, whereas the average water storage capacity world over stands at 40 per cent. Instead of increasing our storage capacity, we have lost more than one-fourth of the storage capacity of our dams, which were completed 40 to 50 years ago. The live water storage capacity that was 16.26 MAF in 1976 has decreased to 13.68 MAF, which equals to a meager 30 days carry over capacity.

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MAN-MADE SOILS
‘COULD BE KEY TO GLOBAL FOOD SECURITY’

Man-made soil from recycling and waste could be the key to ensuring future global food production, scientists have revealed. British scientists are leading a ground-breaking project which could ultimately result in soils being ‘created’ as a way to ensure food security.

University of Plymouth scientists are working with the Eden Project in Cornwall to explore how recycled and waste material could be transformed and then reused in agriculture and other sectors.

They say it could “revolutionise” the soil industry, leading to custom-made soils of varying characteristics being designed for various purposes across a range of locations.

The FAB (Fabricated) soil project is being led by Dr Mark Fitzsimons and Dr Jennifer Rhymes with funding from Agri-Tech Cornwall, a three-year £9.6 million initiative.

Every year, around 12 million hectares of cropland are lost to soil erosion globally while the Food and Agriculture Organisation of the United Nations has suggested that a quarter of the earth’s land area is highly degraded.

Dr Fitzsimons, Associate Professor in Organic Geochemistry, said: “Soil is the root of our survival, and a key component for food security, environmental protection and as a home to wildlife.

“But the quality of it is constantly under threat from a range of factors, notably the intensification of agriculture and carbon loss through climate change.

“As populations continue to grow, we face the real prospect of a soil crisis and taking direct action now is the only way to begin to counter that issue.”

The researchers have sourced a range of waste material from small businesses across the South West made up of composted green waste, clay, grit and bark.

They are currently testing a number of different artificial soil mixtures at sites on the University campus, along with other samples that are more irrigated and controlled.

Those tests will last between 12 and 18 months and are being run in conjunction with lab experiments measuring the performance of the soils, including emissions of greenhouse gases.

The goal is to develop a blueprint for making the ultimate product from recycled and waste materials, ensuring it is stable and fertile and maintaining a reservoir of slow-release nutrients to fuel plant growth without the high demand for fertiliser application.

Scientists say the soils could be used in a plethora of applications – from landscaping and urban restoration to high-value crop production – at sites all over the world.

Dr Rhymes added: “What we’re trying to do is replicate the functions of the soil, but not the soil material itself.

“The science community is making great strides in understanding soil and the complex interactions that occur within it, but our vision is to develop a more sustainable, self-regulating, living system that doesn’t require much subsequent management.

“There is, in fact, the genuine possibility that FAB soil could become more effective than our increasingly degraded soils, and that would be amazing.”

The Eden Project has crafted 83,000 tonnes of fabricated soils in one of the longest running trials of its type.

A world class garden has been created on the soil with tests ongoing so that improvements can be made for future batches.

The work directly feeds into Eden’s overall sustainability agenda.

Dr Rachel Warmington, Leader of the Eden Rainforest Research Group, said: “Working with Mark and Jennifer has allowed us to critically review our fabricated soils, informing the choices we make for our soil recipes and how we manage the Eden soils.

“Fabricated soils have huge potential for repairing agricultural landscapes and particularly in urban food production.”

Agri-tech Cornwall project director Robin Jackson added: “In the UK, farmers are increasingly recognising that soil is one of their most vital assets.

“Sadly, much has been already been degraded or lost – so the prospect of ‘creating’ soils could be a potential game-changer for agriculture, as well as for other industries.”

(With courtesy of ICID)

ECONOMIC OUTLOOK GLOOMY, WARNS ADB

By

Amin Ahmed

ISLAMABAD: Pakistan will continue to face macroeconomic challenges despite tight fiscal and monetary policies to rein in twin deficits leading to deceleration of the GDP to 3.9 per cent in the ongoing fiscal year, says the Asian Development Bank (ADB) in a report released on Wednesday.

In its assessment of Pakistan's economy in the 'Asian Development Outlook' for 2019, the Manila-based bank warns that "until macroeconomic imbalances are alleviated, the outlook is for slower growth, higher inflation, pressure on currency and heavy external financing is needed to maintain even a minimal cushion of foreign exchange reserves."

Moreover, lower revenue collection and higher current expenditure pushed the budget deficit from 2.3pc of the GDP in the first half of 2018-19 to 2.7pc a year later. Pointing out the supply-side slowdown, the bank warns the agriculture sector is likely to under-perform the 3.8pc growth target for the ongoing fiscal year as well amid water shortages.

Large-scale manufacturing reversed 6.6pc growth in the first half of fiscal year 2018 to decline by 1.5pc in the same period of FY19 as domestic demand contracted and rising world prices; crimped demand for raw materials.

Furthermore, a slowdown in agriculture and industry, as domestic demand shrinks, will keep services growth subdued as well.

Stabilisation measures and rising inflation are likely to contain growth in private consumption and investment, while public sector development spending has already slackened. With exchange rate flexibility and declining imports, net exports are expected to contribute to growth.

In first eight months of the current fiscal year, government borrowed more from the central bank and less from commercial banks, freeing up liquidity for commercial banks to boost credit to the private sector by 18.9pc. This sharply increased net domestic assets and nearly doubled broad money growth to 2.8pc.

The current account deficit is expected to narrow in the ongoing current fiscal year but will remain high at the equivalent of 5pc of GDP mainly due to widening trade deficit. It will narrow further to 3pc in fiscal year 2019-20 as pressures on external accounts ease.

Export growth plunged from double digits in the first seven months of the previous fiscal year to 1.6pc in the ongoing fiscal year but is likely to strengthen in the coming months and further in FY 2019-20 as lagged impact of currency depreciation and incentive package for export-oriented industries announced in January kicks in.

Imports fell by 0.8pe in the first seven months of the current fiscal year, with imports other than oil down 5.7pc due to slower domestic economic activity, currency depreciation and an increase in import duties for nonessential items.

Remittances are expected to revive having already risen by IOpc in the first seven months of current fiscal year as Pakistan rupee depreciates further., economic activity in the Middle-Eastern oil exporting countries—major destination of Pakistani migrants — holds broadly steady and government takes measures to facilitate remittances through official channels.

However, inflows that do not incur debt such as foreign direct investment, are expected to be lower in current fiscal year as several CPEC energy projects are near completion.

Financing a high current account deficit in fiscal year 2018-19 will require substantial borrowing and foreign exchange reserves — down to $8.1 billion in February — will likely remain stressed at the end of current fiscal year.

The outlook report highlights that Pakistan lags behind the South Asian regional average on most index indicators; business competitiveness suffers under a challenging macroeconomic environment followed by adverse terms of trade, significantly eroding production and exports.

The report adds that country's exports lack sophistication and diversification condemning them to declining shares in global trade accentuated by the high cost of doing business limiting firms' ability to compete.

Moreover, access to affordable capital is constrained by a shallow and underdeveloped capital market; manufacturing firms face high corporate tax rates, taxes on dividends and retained earnings, cascading taxes levied on inter-corporate dividends and a super tax levied on retained reserves.

The effective corporate tax rate at 49pc diminishes competitive ability of the country's exports in the international markets. High custom duties on machinery increase investment costs. Similarly, high tariffs and unreliable electric power add to production costs.

Pakistan's cumbersome customs and clearance procedures and poor quality of logistics and infrastructure remain a constraint for the just-in-time supply chain management

(Courtesy of Dawn of April 4, 2019)

ELECTRICITY IMPORT FROM CENTRAL ASIA OPPOSED

DRAWBACK: There is evidence that there may be surplus electricity in the short to medium term and thus fixed costs and capacity payments will increase, leading to higher tariffs and circular debt, photo: file

JICA study argues such projects will compromise utilisation of local hydel resources

Electricity planning has always been a contentious issue. Since it is generally risk-free for the investor and carries a lot of liabilities for the buyer, which is the government and the consumer, there is usually controversy and debate.

As enough power generation capacities have been installed, there is no load-shedding and the crisis seems to be over. However, there are other issues like higher cost of supplies and the mounting circular debt. How much more power generation capacity do we require in addition to the already installed and the ones in the pipeline. Should there be energy imports? And what role of renewable energy is to be there. Let us discuss some of the more important issues.

Energy demand and supply issues are related to economic activity, generally measured by gross domestic product (GDP) growth; conservation and efficiency; prices and affordability parameters.

GDP growth has been used mostly due to data availability. Due to conservation and efficiency improvements, energy consumption and GDP have been disconnected; in fact, the energy-GDP elasticity is negative.

In India, with the sophistication in economy and reduction in energy-intensive and raw material content, the energy-GDP elasticity has been going down and has reached a level of 0.5. Perhaps, conservation and energy efficiency issues have also played a role in this.

In Pakistan, there has been much contention in this respect. Many people argue for a faster energy growth than the GDP growth -technically speaking, an energy-GDP elasticity of more than one. On this basis, grotesque projections have been made, which have often not been realised.

In the power sector, two major studies were commissioned in the current decade - one was done by Canadian consulting company SNC in 2011 and the other by a Japan International Cooperation Agency (Jica) consultant in 2016. The National Transmission and Despatch Company (NTDC) was the counterpart local organisation.

Results and assumptions both seem to be contradictory. SNC report assumes low and high GDP growth rates of 5.8% and 6.5% respectively. Jica report assumes GDP growth rates of 7.9% and 8.2%. However, strangely, their results are the opposite. Despite the low GDP growth scenario taken by SNC, its power demand projections are 149,665-186,288 megawatts for the year 2035, which is certainly an unrealistic projection.

Jica consultant, who assumed very high and rosy GDP growth rates, came out with comparatively low although realistic projections. The corresponding base case and high demand scenario figures are 82,288 and 104,961 MW. Historical power demand growth in the country has been around 4-5%.

Energy trading networks work well in geographically contiguous areas and not through a distance of 1,000 km of war and terrorism-prone area

The NTDC has recently submitted a least cost generation plan to the National Electric Power Regulatory Authority (Nepra), which puts power demand in 2040 at 80,000 MW. However, the NTDC estimate is for the Pakistan Electric Power Company (Pepco) region and if Karachi is added, the demand may go up to 87,oooMW or above.

It appears that NTDC has adopted Jica figures. Although the two reports - Jica and SNC - have different modeling methodologies and selection of parameters, the contradictions and huge differences shake confidence in foreign consultant reports and projections based on which we make investment decisions.

However, it is impossible to make exact predictions. Life and business cannot be predicted in exact terms. However, margin of error should be reasonable.

Most market economies have surplus electricity as surplus creates competition. It is questionable as to how much surplus investments and capacity a poor economy can afford. Already, there is evidence that there may be a surplus in the short to medium term and thus fixed costs and capacity payments will increase, leading to higher tariffs and circular debt.

Clean energy

The most important current issue and controversy is renewable energy despite consensus that renewable and distributed energy is the future. However, the future has arrived. Solar and wind power may be available under five US cents or even lower.

There have been decision on competitive bidding but Nepra has been issuing upfront tariff. The Central Power Purchasing Agency-Guarantee (CPPA-C) has been pointing out it does not have resources for paying for additional commitment.

The local investor network has been responsible for lobbying for the early inclusion of renewable solar and wind power capacity in the portfolio. However, they are at the risk of losing market to the more efficient and richer Saudi investors who would like to invest in 2,000 MW of solar power.

If we are talking about 6o,oooMW power demand by the year 2030, it means another 25,000 MW or more of new installations between now and 2030.

At 10% share, 6,000 MW of solar and wind energy may survive in the network and thus 4,000 MW can be added, assuming 2,000 MW is already there.

Sequencing would be an issue. Who goes first and that is easily handled by competitive bidding, be it reverse auction or otherwise.

Finally and interestingly, the Jica report recommended against Central Asia-South Asia (CASA) 1000 project on cost grounds despite pressure from the ministry to the

contrary. It argued that such projects would compromise the utilisation of local hydel resources. Energy trading networks work well in geographically contiguous areas and not through a distance of 1,000 km of war and terrorism-prone area.

Such exchanges may be more suitable across Sindh and Punjab border or on the western side with Iran. One option is blocked by the Indian attitude and the other by US sanctions on Iran. It is surprising to come across the news of MoUs being signed for electricity import, when the country is already facing the current account deficit crisis.

The writer has been member energy of the manning commission

(Courtesy Express Tribune of April 1, 2019)

COAL SHARE IN ELECTRICITY PRODUCTION MAY REACH 18%

FARAZ AHMAD
KARACHI



CAREFUL: Pakistan has to make sure that its energy mix is in sync with global future trends, where the country should not fall in a trap to replace currently inefficient furnace oil with an unfavourable alternative, such as coal, etc.

Globally coal-fired capacity is constantly being replaced with cleaner sources

If the adverse effect on climate was not compelling enough to adjust the carbon emissions level, the economic shift from changing energy landscape will eventually force global powers to reduce their carbon footprint.

Energy production is the single largest source of global greenhouse emissions and reduction in the release of such harmful gases into the atmosphere is very critical for achieving objectives of the 2015 Paris Agreement on climate change.

Under the Sustainable Development Scenario (SDS), energy-related emissions are to be reduced by half from current levels by 2040 and eventually to net zero emissions by 2070. The US pullout from the Paris climate agreement under the Trump administration last year could not alter the course of phasing out coal from the energy mix in the US, in fact it did not even slow down the trend.

In the past 10 years, US electricity generation from coal has declined from 44% to 27%, according to the 2019 edition of the "Sustainable Energy in America - Fact Book" produced for the Business Council for Sustainable Energy (BCSE) by Bloomberg NEF. The gap was mostly bridged by renewable and gas-based power generation.

Tides are changing even faster in China, which is the second largest importer of coal and contributes around 14% to the total world import, where the pressure to reduce the impact on environment is mounting.

The market for coal is sensitive and volatile these days due to a slowdown in the Chinese economy and the effect of trade war. The recent slowdown in processing of coal shipments from Australia in the northern Chinese port of Dalian created panic among Australian investors in particular and the world commodity market in general.

The price of coal (ICE Richard Bay Coal), which was hovering above $100 per ton at the end of last year, continuously spiraled downwards until it broke down below the $80 level recently. While the continued fall in coal prices could mean better margins for its users such as cement industry, steel industry and coal-based power plants, there are conscious and systematic efforts around the globe to reduce the reliance on coal for power generation.

Despite all the pressure from environmental agencies and sudden climate change events, coal is still used to produce 40% of electricity around the globe as per International Energy Agency (IEA) and will require a 5.6% annual decrease in coal extraction to meet the stringent SDS targets. Cost competitiveness of renewable power has gained critical mass.

Biomass for power, hydroelectric power, geothermal and onshore wind can all now provide electricity at the tariff which is comparable with conventional sources.

As per latest data of the International Renewable Energy Agency, the cost of onshore wind turbines fell 18% between 2010 and 2016 and they provide very competitive electricity at four cents per kilowatt-hour (kWh). A further reduction in the cost of production and increased efficiency will bring the inflection point even closer, where these alternatives will become more cost effective than fossil fuels.

As per the State of Industry Report 2017, published by the National Electric Power Regulatory Authority

(Nepra), coal is currently contributing 3% to the energy mix for power generation in Pakistan and is expected to rise to 18% by the year 2021, once all coal-based power plants come on line.

From the report, it appears that Pakistan is joining the party a little late in sharp contrast to the global trend, where coal-based capacity is constantly being replaced with more cleaner, efficient and renewable sources.

According to the US Energy Information Administration (EIA), around 4.5CW of coal-fired capacity is going to be retired this year in the United States, whereas around 13.7CW of capacity went offline last year alone.

Pakistan has to make sure that its energy mix ratio is in sync with the global future trends, where the country should not fall in a trap to replace currently inefficient furnace oil with an unfavourable alternative, such as coal, without fully exploring all the options and implications.

Also an effective compliance regime should be in place to ensure that existing coal-based power plants are operated and maintained efficiently with reduced emission levels in the environment.

OBITUARIES

January 2019 to June 2019

Fateha for the Departed Souls

1. The **wife** of Engr. Abdul Jabbar Uppal, Chief Engineer (R) Irrigation Department, Punjab, passed away on January 21, 2019

2. **Engr. Ch. Abdus Salam** former Secretary (C&W) Department, Punjab and former President Pakistan Engineering Congress, passed away in Lahore on February 19, 2019.

3. **Engr. Shah Nawaz Khan**, an Icon of Engineering profession, former Chairman WAPDA, former Chairman Pakistan Engineering Council, passed away in Peshawar on March 21, 2019.

ELITE CAPTURE COSTS ECONOMY RS.860 BILLION PER YEAR

CAPACITY: According to former finance minister Dr Hafiz Pasha, the FBR's tax-to-GDP potential is not more than 14% and the government should resist pressure from the IMF to increase the ratio beyond that threshold.

Asad Umar believes open, rule-based economy can break elite stranglehold

Finance Minister Asad Umar said on Tuesday that an open and rule-based economy could break the stranglehold of elite on the economy as an independent study puts the annual cost of elite capture at a staggering Rs86o billion.

If the Pakistan Tehreek-e-Insaf (PTI) government manages to break the iron grip of the elite, the benefit in terms of additional revenues will end the need to levy more taxes under a possible International Monetary Fund {IMF} programme.

"Rule-based, open and transparency in economic decision-making is the solution to the elite capture," remarked Umar while responding to a question on findings of a World Bank report.

The minister said strengthening parliament and ensuring institutional oversight would also help break the stranglehold of the elite.

According to the World Bank report, Pakistan's economy right now is captured by four influential groups that have frustrated efforts to bring reforms. These are civil servants, landowners, industrialists and the military. The bank states that there is evidence that Pakistan's elite has used this power in the past to undermine reforms that would have reduced their influence.

The report also stated that the military's security-centric policies were a tool to extract state resources. But the finance minister disagreed. "If the military is using security-centric policies to extract resources it means the federal government is unable to play its role effectively," he said.

"It is the government's responsibility to own a policy or change it if it does not support it," he added.

The finance minister said previous rulers of the country enjoyed their positions but blamed the military for their own faults.

A recent research suggested that the cost of elite capture was Rs86o billion or nearly 2.5% of gross domestic product (GDP), said former finance minister Dr Hafiz Pasha on Tuesday. He was speaking at the National Tax Conference, organised by the Institute of Chartered Accountants of Pakistan (ICAP).

He said the Rs86o-billion cost had been worked out on the basis of tax expenditure that the elite influential groups had enjoyed. He pointed out that income tax exemption for trusts and agriculture was among few examples, adding who knew who owned these trusts.

"The imposition of 25% regulatory duty on the import of sugar is yet another example of elite capture," said Pasha. "The state's capture through the culture of Statutory Regulatory Orders has to end."

The cost of elite capture is close to what Pasha has predicted, who believes that the IMF can ask Pakistan to levy additional taxes to increase the tax-to-GDP ratio to nearly 17%. "If we enter into an IMF programme having fiscal deficit heading towards 7% of GDP and tax-to-GDP ratio falling this year to 12.5%, the IMF may ask Pakistan to impose new taxes equal to 3-4% of GDP in the next two years," said Pasha.

He feared that it would put an additional burden on the poor and the IMF would not care from where these taxes were generated. Pasha pointed out that recent work suggested that Pakistan's tax potential was not more than 17% of GDP. "Our tax-to-GDP ratio was 13% at the end of last year and this means at best the government can enhance this ratio to 17%."

However, he was of the view that the FBR's tax-to-GDP potential was not more than 14% and the government should resist pressure from the IMF to increase the ratio beyond that threshold.

Participants of the National Tax Conference also discussed pitfalls of the FBR's regressive tax regime. Most of the problems that Pakistani businessmen faced today or even a bad ranking in the World Bank's Ease of Doing Business index were because of the tax policies, commented Ashfaq Tola, a member of the government's Tax Reforms Implementation Committee (TRIC).

He said 60% of the money laundering was taking place in the real estate sector and the FBR and other government departments were doing nothing.

Poor tax collection was because of an inefficient and corrupt FBR and also the poor culture of tax compliance, said Abid Shaban, another member of TRIC. He said there were 30 million current accounts in Pakistan, but only 600,000 business people filed returns in tax year 2017. There were 3.5 million traders but registered trading units were only 135,000, said Shaban.

Chartered accountants and economists suggested forming an integrated National Tax Agency aimed at improving tax compliance and lowering the cost of being a return filer. Shabbar Zaidi, senior partner of A.F. Fergusion chartered accountancy firm, said abolition of the FBR was not the solution, adding before undertaking FBR's reforms, the banking and foreign currency regime reforms had to be brought.

(Courtesy Express Tribune March 20, 2019)

CBC BANS USE OF POLYTHENE BAGS IN ITS JURISDICTION

By

AFTAB KHAN

KARACHI

The Cantonment Board Clifton (CBC) has decided to impose a ban on the use of polythene bags in its jurisdiction. As part of this campaign, residents will be persuaded to use paper or cloth bags instead of polythene ones. Shopkeepers selling household groceries and other items have also been directed to stop the commercial use of polythene bags.

A special campaign will run for 15 days to raise awareness among residents and visitors to Sea View, which also falls under the CBC jurisdiction. After the 15-day campaign ending on April 4, the CBC will fine those found violating the ban.

The Sindh government has already banned the sale and use of plastic bags and products. Section 14(3) of the Sindh Environment Protection Act 2014 states that "no person shall import, manufacture, stockpile, trade, supply, distribute or sell any scheduled plastic product which is non-degradable". At several times during the last couple of years, the Sindh government has made announcements to this effect. The last such move came in November last year, when the Sindh Cabinet decided to impose a phase-wise ban on the use of polythene and plastic bags in the province, with Sukkur being the first district. The ban would be enforced in Karachi in the next phase, the Cabinet had announced. However, it was hardly ever enforced.

Cost to the environment

According to the CBC administration, the decision to ban polythene bags has been taken due to their various negative effects on the environment. Over the last few years, the CBC has launched various drives such as plantation campaigns and other activities to improve the environment.

However, all these activities have been overshadowed by the unrestricted use of polythene bags, which have been found to be the single largest contributor to solid waste pollution. These polythene bags do not only increase the garbage spread in the streets but also affect the sewerage system when they get stuck in the drainage lines.

According to CBC representatives, between 320 and 350 metric tons of garbage is lifted from their jurisdiction on a daily basis. In the absence of a recycling mechanism, the plastic waste is disposed of in landfill sites in Surjani and Hub.

Polythene bags have also become a major threat to marine life. In turn, they are also dangerous for humans, who consume the same marine life that inadvertently swallows these plastics. Experts have warned that when these polythene bags find theirway into the sea, they are broken down into micro plastic particles and are then consumed by marine life. This poison is included in human food through fish, prawns and other sea food.

A campaign will run for 15 days to raise awareness among residents and visitors to Sea view, which also falls under the CBC jurisdiction.

Shopkeepers warned

Meanwhile, shopkeepers and vendors within the CBCs jurisdiction have been instructed to stop the use of polythene bags. These instructions would be announced repeatedly on megaphones and in the form of written notices by CBC teams during the 15-day movement. Action against violators would then be initiated after April 5. Heavy penalties will be imposed on shopkeepers found violating the ban.

The CBC is also considering distributing paper or cloth bags among residents and shoppers to encourage the use of these alternative materials.

In response to a question regarding how the ban would be enforced on picnickers coming to Sea View, a spokesperson said that they had already placed garbage bins at short intervals along the promenade from McDonald's to Village Restaurant.

"People are unaware of the damage caused by polythene bags and so they don't throw the garbage in the bins although they are placed after every few steps," said the spokesperson.

The restriction would be imposed on the citizens coming for picnic as well as vendors running the stalls at Sea View, said the CBC spokesperson. Besides, banners are being put up at different locations to raise awareness among residents of Clifton and those coming for picnic.

(Courtesy Express Tribune March 20, 2019)

BACK TO RENEWABLES

THE government has made the right decision to reopen the proposed investments in renewable energy that had been blocked last March. The renewable energy policy framework is in a state of flux at the moment as the new policy is being discussed among various stakeholders. There will undoubtedly be some level of discontentment within the renewable energy industry in Pakistan at the caveats in the decision, such as making those whose tariff determinations are more than a year old return to the regulator for fresh tariffs, which will doubtless be substantially reduced. Given the speed with which renewable energy tariffs are dropping worldwide, a system run by a single tariff-setting body like Nepra will struggle to keep pace. This is creating malignant incentives in some cases, where those who got in the door early have locked in very high tariffs competitive with thermal power for the next 25 years, while those left out have to see their tariffs being whittled down as time passes. This naturally creates unhappiness at the sheer disparity between the returns being made by different parties.

To really ignite the renewable revolution in Pakistan, the government needs to reconsider the model of setting upfront tariffs in the first place and, instead, move towards a market-based pricing regime. On top of that, we need to move away from the model of large utility-scale projects and build the right structure of incentives to promote point-of-consumption generation for solar power — which basically means having solar rooftop panels, and encouraging people to invest in them. Simply tweaking the tariffs will only garner more wrangling among industry players as prices around the world continue to fall rapidly. This means a near-complete rethink of the private power policy under which all power generation has been contracted in this country for almost a quarter of a century now, and which has opened the doors to large-scale abuse and rent-seeking behaviour within the power sector. This government campaigned on the promise of change, particularly big change of the transformative type. In the power sector, it has a clear opportunity and mandate to work towards this objective. A surplus in power generation means there is a few years' gap in which to put in the plans, and the list of private investors ready to enter is quite long. The solar moment is now, will the government seize it?

(Courtesy in Dawn, March 1st, 2019)

GOVT. REVIVES BLOCKED RENEWABLE ENERGY PROJECTS

ISLAMABAD: The government on Wednesday decided to allow partial revival of renewable energy projects blocked in March last year by the PML-N government subject to a revised tariff mechanism and greater decisive role to National Transmission and Despatch Company (NTDC) to provide interconnection facility.

It also provided an opportunity to the Sindh government to provide interconnection grid facility for renewable projects (RE) projects that it had issued letters of interest (LoI) but were affected by the government's decision of March 2018.

The decision was taken at a meeting of the Cabinet Committee on Energy (CCoE) presided over by Finance Minister Asad Umar. The meeting also reviewed about 20 per cent increase in revenue collection by power distribution companies through increase tariff, fuel price benefit, loss reduction and better recovery.

The CCoE noted that between November 2018 to January 2019 collection of power bills amounted to Rs244 billion compared to Rs204bn, showing an increase of almost Rs39.7bn. The major increase of Rs16bn came from increase in tariff while Rs13.3bn higher revenues were earned due to improved recovery from consumers. About Rs6.1bn saving was achieved in three months through loss reduction and Rs4.5bn through higher fuel price adjustment.

The CCoE approved proposals from the Power Division, providing for all future RE investments to be treated in line with the Renewable Energy Policy 2019 that envisages a framework consistent with the current international market norms and greater consumer benefits. The policy is currently being reviewed by stakeholders and would be formally taken up by the CCoE later but guiding principles were approved on Wednesday.

It was decided that all projects which have been granted letters of support (LoS) by the Alternate Energy Development Board (AEDB) shall be permitted to proceed towards the achievement of their requisite milestones as per the Renewable Energy Policy 2006. However in those cases where more than a year has elapsed since tariff determination by the National Electric Power Regulatory Authority (Nepra), the rates would have to be reviewed by the regulator as per policy.

The committee was informed that the 2006 policy offered liberal risk covers and attractive power purchase tariffs to the private sector with gradual transition to open market competition with utilities free to choose between supply options competing against each other. It was reported that a number of projects had issued LoI by the provinces. Several of these projects were granted tariffs and generation licences by Nepra and LoS by the AEDB but the then government stopped all these projects beyond a cutoff date without a revised policy for the transition.

It was decided that any resource risk linked with RE projects being considered as pipeline projects under the 2006 policy would be consistent with the Nepra's decisions taken in various tariff determinations dealing with such projects and resource risk for wind, solar and hydro would be henceforth borne by the seller.

Also, all processing of the subject projects would be linked with the date of grid interconnectivity as provided and confirmed by NTDC.

All projects that have been issued LoI, granted determination of tariff by Nepra and issued a generation license would be allowed to proceed ahead towards the achievement of their requisite milestones as per the 2006 policy. However, if the tariff determination has been done since more than one year or if the tariff validity period, has elapsed, Nepra would be requested for review of the same to make it consistent with the current market environment, lower cost and consumer interest.

In case of wind projects that fall in the above categories and are situated in the wind corridor of Jhimpir, Sindh, the NTDC and Sindh government would work on the latter's proposal for the construction of evacuation facilities from the said corridor by the provincial government and would be reflected in a firm agreement between the two.

Based on the NTDCs confirmation of evacuation and as per the timeline decided for completion of the projects, the Central Power Purchasing Agency-Guarantee would consider granting of consent. Also projects that have been issued LoI prior to the expiry of the of RE Policy 2006 on March 08, 2018 but have not received a tariff determination from Nepra would be allowed to proceed ahead subject to becoming successful in the competitive bidding process to be undertaken by the AEDB.

For projects which are regarded successful in the bidding process, LoS shall be issued subsequently allowing the projects to achieve Financial Closing as per the time period allowed in the document. The sponsors willing to proceed with the development of their respective projects under this mechanism shall be required to provide an undertaking to withdraw all lawsuits against federal and provincial government and their entities without prejudice.

(Courtesy in Dawn, February 28th, 2019)

THE LAHORI STARGAZER WHO LANDS UP IN ANTARCTICA

Makes nation proud by becoming first Pakistani woman to be selected for Homeward Bound programme

ISHRAT ANSARI

Stargazer Dr Tayyaba Zafar always aimed for the sky and its galaxies. While she may not have reached there yet, Dr Zafar has managed to reach Antarctica, the final frontier on Planet Earth.

Originally from Lahore, Dr Zafar made the nation proud by becoming the first Pakistani woman to be selected for an Antarctic research trip under the Homeward Bound programme.

Around 80 women were selected from 26 countries and Dr Zafar was the only one from Pakistan. The programme aims to increase the influence and impact of women global leaders and involved specialists in science, technology, engineering, mathematics and medicine.



Under the programme, Dr Zafar visited Antarctica for three weeks. Apart from the daily leadership lectures, the women scientists visited various sites being affected by climate change. They covered everything from different penguin species colonies to country bases, melting glaciers, zodiac cruises and whale watching.

Talking to *The Express Tribune,* Dr Zafar says she gazed at the stars, but the trip to Antarctica was a celestial experience back on Earth. "You can feel the positivity and inhale it. You can reflect yourself."

The trip to Antarctia was part of a one year programme. During those 12 months, the participants attended online sessions on various subjects, including leadership qualities.

"Although it was a great experience, some of us fell seasick and the most common effect was dizziness," she recalls.

The 35-year-old shares that she has loved astronomy since childhood and taken inspiration from the stars, sky and galaxies. In school, physics and mathematics remained her favourite subjects.

"In Pakistan, the subject of astronomy isn't taught. Since I liked astronomy, I used to buy books on the subject and read them for pleasure. Studying the subject, in depth, became a passion."

Dr Zafar obtained her early education in Lahore. She has done a master's in physics from Pakistan and later lectured at the Punjab University for a year and a half. "In 2007,1 won a scholarship for PhD studies at the DARK Cosmology Centre of the famed Niels Bohr Institute in Copenhagen."

Discussing her area of expertise, Dr Tayyaba says she focuses on galaxies . Although galaxies have nothing to do with the environment, this project helped her understand climate issues. "In Pakistan, we use a lot of plastic which emits carbon and is destroying our planet."

Dr Zafar says there is a need for more girls or women to enter the field of science. She adds that the way to inspire them is to encourage the reading of science and astronomy books at an early age. She stresses that girls also should be pushed to read the biographies and autobiographies of renowned women scientists. "This will show them that the subjects of science and astronomy are not only for men. If some women have made it, they can make too."

It saddens me to see talented young Pakistani women not reaching their true potential

Dr. Zafar has been supervising MPhil students at the Punjab University, but finds it unfortunate that barely any girls are interested in science, especially astronomy. The explorer and scientist adds she has failed to convince even one girl to apply for scholarships abroad.

There is no dearth of talented girls in Pakistan, but almost every one of them has an issue. Some of them are not allowed to go abroad and other get married, she bemoans. "It saddens me to see talented young women not reaching their true potential."

Dr. Zafar remembers that her family was not easily convinced over her travelling alone abroad when she secured her PhD scholarship in Denmark. However, her passion to study and excel in her field softened their hearts, she says.

"Don't give up on your mission. I didn't. We have one life and must live it to the fullest. Each one of us has a shining star inside us and we need to follow it; seek guidance from it," she says in her message to young women.

Dr. Zafar says the Homeward Bound programme has taught her to plan ahead. She feels better equipped and in a position for concrete strategic planning. "I will suggest women scientists apply for this global programme and represent Pakistan on an international platform." In the future, she hopes to set up her own research group and mentor students. At present, she is working as a lecturer at the Macquarie University in Australia.

(Courtesy The Express Tribune 25-2-2019)

ROADMAP FOR $21BN SAUDI INVESTMENT FINALISED

By

Khaleeq Kiani

Pakistan is expecting $21 billion worth of seven memorandums of understanding (MoUs) signed with Saudi Arabia to come to fruition in three phases over the next six years.

The two sides have set up two major follow-up forums to ensure timely completion of feasibility studies and project implementation including the top level Saudi-Pakistan Joint Supreme Coordination Council (SPJSCC) and a Joint Working Group (JWG).

The SPSCC will be led by Prime Minister Imran Khan and Saudi Crown Prince Mohammed bin Salman bin Abdulaziz Al Saud while joint working group on energy would be led by Saudi Minister for Energy and Industry Khalid Al Falih and Petroleum Minister Ghulam Sarwar Khan.

Officials involved in two-day bilateral engagements said three initiatives of $7bn are expected to be completed in the first phase of 1-2 years (short-term). These include about $4bn Saudi investment in two regasified- liquefied natural gas (RLNG) based power plants in Punjab. The sale of two projects was, however, expected to go through the open bidding process even though the previous government had parked a major part of $1.5bn 'Saudi gift' in the Pakistan Development Fund to finance the two power plants.

Another $2bn investment is expected from ACWA Power within two years, mostly in renewable energy projects in the coastal areas of Balochistan and Chaghi wind corridor, based on feasibility studies to be conducted in the near future, officials said.

ACWA Power is a Riyadh-based developer, investor, co-owner and operator of a portfolio of power generation and desalinated water production plants in 10 countries Including in the Middle East and North Africa, Southern Africa and South East Asia regions.

In addition, a $lbn investment from Saudi Fund for Pakistan is also expected in first two years as participation in projects like Diamer-Bhasha and Mohmand dams, Jamshoro and Jagran power projects.

The mid-term investment up to $2bn is anticipated in 2-3 years. These include smaller petrochemical projects and food and agriculture projects of $lbn each.

The long term (4-6 year) Saudi investment worth $12bn is expected in two major projects. These include $10bn oil refinery to be set up by Aramco and $2bn investment in Mineral Development.

The feasibility study for oil refinery and identification of mineral projects are yet to be made, officials explained, adding that the formal agreements on all these projects would be signed on a fast-track basis as soon as their feasibility studies are completed.

The two sides decided to set up the SPJSCC at the highest level to enhance bilateral economic and business relations in various fields in an institutionalized manner and resolve any hiccups at the very outset. The meetings of the council will be held in the two countries on an alternative basis.

The two sides agreed to make use of all available channels to promote bilateral trade, investment and promote communication between the two peoples and businessmen. The Joint Commission on Commerce and Trade, which is now part of the SPJSCC shall facilitate bilateral trade in specific sectors and products.

The two sides agreed to further strengthen measures to promote trade, participate in exhibitions and events, welcome business meetings from both countries, and encourage the private sector to take the lead in building a strong economic partnership between the two brotherly countries.

The two sides expected the total investment opportunities worth $20bn would increase the mutual investment and volume of bilateral trade.

A joint statement quoted Saudi side as expressing its appreciation for the initiatives taken to improve the conduct of business and facilitate foreign direct investment, and hoped the potential of the China-Pakistan Economic Corridor (CPEC) will contribute to the development and prosperity of the region.

In follow-up to the signing of MoUs, both sides agreed to have expeditious exchange of information to carry out feasibility studies and discussed other areas of cooperation including supply of petroleum products and LNG on a deferred payment basis.

Mr Falih said his country would look into some other mutually beneficial investment opportunities in energy sector of Pakistan.

Investor moot

Separately, a Pak-Saudi Investors Conference on the sidelines agreed to promote bilateral trade to its true potential as its existing size of $3.7bn was fall below the strength of brotherly relationship. Adviser to Prime Minister on Commerce, Textile and Industry Abdul Razzak Dawood and Saudi Commerce Minister Majid Bin Abdullah Al Qasabi co-chaired the conference.

Dawood said there were many untapped potential areas which should be explored for mutual benefit and take advantage of trade and investment opportunities like in agricultural, natural resources and human resource in Pakistan and logistic, mining and religious tourism in Saudi Arabia. He assured the guests that Pakistan would facilitate and provide a level playing field to Saudi investors.

He said Pakistan's economy was heading in the right direction but was facing energy shortage, when China came forward and decided to initiate investment in different energy generation projects under CPEC. He said the government was working on renewable energy policy to improve energy mix with alternate energy from existing 4pc to 30pc by 2025 to shift away from expensive oil and gas.

A statement quoted Mr Dawood as saying that Saudi investors and businessmen showed keen interest to invest in petroleum and energy generation sectors as the huge scope of investment were existing with lucrative rate of returns.

Saudi Minister for Commerce Majid Bin Abdullah Al Qasabi said Pakistan was a nation of passion and dedication, and the compass of bilateral relations was moving towards new direction.

Terming the current trade volume of $3.7 billion between the two countries as low, the Saudi minister said that this volume was very moderate and it should be enhanced by exploiting new areas of trade and development in the country. He hoped the current visit would help ease the bureaucratic challenges on both sides.

(Courtesy Dawn 19-2-2019)

CLIMATE CHANGE

'FIVE-YEAR PLAN MUST INCLUDE CLEAN ENERGY SOLUTIONS'

Secretary says challenge is to achieve clean energy mix with more dividends



COLLABORATION: The SDPI, Planning Commission and Unescap have joined hands to develop models, which can lead to alternative scenarios of Pakistan's future energy demand and supply needs.

Joint Secretary and Planning Commission's Climate Change and Energy Section chief Arshad Ali Chaudhary has underlined the need for moving towards cleaner, greener and affordable energy solutions and incorporating them into the 12th five-year plan, which is at the finalisarion stage.

"In Pakistan, power generation alone is not an issue, but also power distribution, transmission and affordability with minimum theft and line losses, which are major challenges and require due attention of the policymakers," he said.

Chaudhry was addressing the inaugural session of a training workshop titled "Evidence-based policies for sustainable use of energy resources in the Asia-Pacific region", organised by the Sustainable Development Policy Institute (SDPI) in collaboration with the Ministry of Planning, Development and Reform and the United Nations Economic and Social Commission for Asia and the Pacific (Unescap).

He emphasised that the challenge for the country was to achieve a clean and green energy mix with negligible environmental impact and more economic dividends.

Unescap Chief of Energy Division Michael Williamson said "the choices we all have made in the past to use oil and biomass for power generation now lead to dire consequences in the form of climate change."

"We have to change our priorities towards the energy mix. For that, there is a need to strengthen capacities of the policymakers in developing evidence-based policy and planning for sustainable use of energy resources at national and regional levels. Pakistan has wonderful opportunities and potential in solar and wind energy," he said.

SDPI Executive Director Dr Abid Qaiyum Suleri pointed out that the current primary energy mix was dominated by traditional biomass, oil and natural gas with coal, whereas nuclear, hydel and other renewables were playing a limited role.

He said the government, in its recent economic reform package, removed all sorts of taxes and duties on the import of renewable energy products - a positive step forward towards green energy cornrnitrnent.

The SDPI Executive Director said the institute was now collaborating with the Energy Research Institute of China for evidence-based research and assessment of the energy-sector challenges faced by Pakistan and the region,

"SDPI continues to extend its research in the energy sector on topics including Sustainable Energy for All (SE4AU), Pakistan's perspective and bioenergy, and sustainability in South Asia," he added.

SDPI Joint Executive Director Dr. Vaqar Ahmed said planning departments of federal and provincial governments were currently in the process of finalising long-term growth strategies where the Planning Commission was also formulating the 12th five-year plan.

As part of the five-year plan, he said, it was important that Pakistan put in place and follow an integrated energy plan. "It is also important to remember that the policies being proposed are based on scientific evidence. For this purpose, the SDPI, Planning Commission and Unescap have joined hands to develop energy planning models, which can develop alternative scenarios of Pakistan's future energy demand and supply needs," he added.

These exercises will also forecast investments, which may be requested to meet future energy demand.

Ahmed said such models would also outline how to protect die environment, which could be ensured through the use of cleaner energy fuels. "This exercise will also involve collaboration with the Ministry of Climate Change," he added.

HAZADOUS PRACTICE

POLLUTED WATER OF NULLAH LEH BEING USED FOR CULTIVATION

The crops include wheat, corn, coriander and other vegetables and fruits

Despite a caveat from the health department about the presence of poliovims and dengue larvae in the vicinity, cultivation of crops irrigated by from the polluted sewerage water of Nullah Leh continues on a large scale along the banks of nullah in Rawalpindi.

This illicit practice is done by the influential people who have occupied the land there.

Water course is changed for irrigation for these crops by embankments in canal.

This hazardous practice is in full swing in the areas of Safdarabad , Dhook Dalaal, Kalamabad, Dhook Ratta, Fauji Colony, Jhanda Chichi , Peru Duhai, Katariyan along with other adjoining areas of Nullah Leh

The crops include wheat, corn, coriander, mint leaves, rose petals and other vegetables and fruits while the sole water source for the cultivation of these crops is the effluent laced water from Nullah Leh.

An agricultural department officer, on condition of anonymity, said that teams of agricultural department used to destroy crops irrigated with chemically polluted water before reaching the market.

The agricultural department has stopped these actions after the establishment of Punjab Food Authority as it is now the jurisdiction of the food authority, he added.

District Health Officer Dr. Naveed Akhtar told that the health department focuses on the banks of Nullah Leh for the protection from polio and dengue larvae. Surveys had been conducted in the past while awareness and vaccination had also been provided to the people.

Dr. Naveed added that that health department could not take any action on its own while it was also the responsibility of Municipal Corporation, District Administration and Punjab Food Authority. An owner of the polluted crop fields owner. Chulam Hussain told that the cultivators do not have their own lands. The crops are usually grown before and after the rainy season and irrigated with water from Nullah Leh. he added.

He said that he had never received any complaints of dengue, polio and any other illnesses from the consumers of these crops.

INCLUSIVE ECONOMIC DEVELOPMENT



LIU ZHENMIN

The writer is the Under-Secretary-General for Economic and Social Affairs, United Nations

World leaders have committed to ending poverty everywhere for all people by 2030. Achieving this aim means facing up to the need for dramatic declines in inequalities— in income, in opportunity, in exposure to risk, across gender, between countries and within countries—over the next decade.

Inequality is a well-recognised barrier to poverty eradication and many other development challenges. It features in multiple dimensions across the 2030 Agenda for Sustainable Development— the universally-adopted plan to promote social well-being while protecting the environment. According to many metrics, income inequality among countries has declined somewhat in recent decades, driven primarily by strong growth in East Asian and South Asian economies. But there are many countries, particularly in parts of Africa, Western Asia and Latin America and the Caribbean, where income levels have continued to fall further behind, exacerbating income inequalities between countries.

The UN's latest analysis in the World Economic Situation and Prospects 2019 indicates that per capita income levels essentially stagnated or declined in a tool of 47 developing and transition economies last year. Most of these countries have been consistently falling behind for several decades. This poses an enormous challenge as countries strive to reduce poverty, develop essential infrastructure, create jobs and support economic diversification.

If this trend continues, eradicating poverty and creating decent jobs for all will become increasingly out of reach. Weak economic performance is also linked to insufficient investment in quality education, health services, social protection, programmess for marginalised groups and mitigation and adaptation to climate change. Faster GDP growth alone will not necessarily lead to broad-based improvements in living standards. Deep inequalities also persist in the distribution of income within countries, acting as a major barrier to development progress. High inequality within countries is associated with social exclusion and fragmentation;

weaker institution-building and governance; and increased risk of violence and internal conflict.

Fundamental transformations are needed going forward, to narrow the income gaps between and within countries. According to UN estimates, without significant changes in behaviour, more than 7% of the global population may remain in poverty by the year 2030, including about 30% of the populations in Africa and the least developed countries (LDCs). In Africa, where the population is expanding at a rate of more than 2% per year, reducing the level of extreme poverty to below 5% by 2030 will require a combination of double-digit GDP growth and dramatic declines in inequality; well-outside the realms of historical precedence.

Integrated and cross-cutting policy measures that raise prospects for economic growth and reduce income inequalities are essential to shift the world towards a more sustainable and inclusive path. This includes investing in education, healthcare, resilience to climate change, and financial and digital inclusion, to support economic growth and job creation in the short-term, while promoting sustainable development in the long term.

Macroeconomic stability and a strong development-oriented policy framework, including a well-functioning and robust financial system, are key to successfully tackling inequality. Well-designed fiscal policies can help smooth the business cycle, provide public goods, conect market failures and directly influence the income distribution. Broadening access to quality education is also crucial, coupled with employment policies, such as raising minimum wages and expanding social protection. Prioritising rural infrastructure development, through public investment in transport, agriculture and energy, can also support poverty alleviation and narrow inequalities within countries. While there is no one-size-fits-all policy prescription that guarantees delivery of a more equal and prosperous society, one overarching message is clear: calls to eradicate poverty are meaningless without concerted and committed policy action to reduce inequality.

KEY RECOMMENDATIONS

MID-TERM SYMPOSIUM

ON THE THEME OF

"WATER SCARCITY-STRATEGIC APPROACH"

Saturday, February 23, 2019

Pakistan Engineering Congress has celebrated Mid-term Symposium. Papers presented at the event are printed in a book form and distributed to concerned Public / Private Sectors complimentary.

This year also the World Water Day, on the theme of "***WATER SCARCITY-STRATEGIC APPROACH***", was celebrated on ***February 23, 2019***. The Welcome address was presented by Engr. Tariq Rashid Wattoo, President Pakistan Engineering Congress. The Chief Guest was Engr. Mehmud-ul-Hassan Siddiqui, Consultant Irrigation Department, Punjab. The First Technical Session was chaired by **Dr. Muhammad Abid Bodla.** 8-Technical Papers were presented in the Session by renowned authors on different water related topics. The post-lunch Technical Session was chaired by **Engr. Ch. Ghulam Hussain.** 3-Technical Papers were presented in this Session, followed by Question / Answers Session of about half an hour.

Given below are the recommendations made by the Speakers: -

1. Paper: STRATEGIC APPROACH TO ALLEVIATE WATER SCARCITY THROUGH RESERVOIRS INCLUDING IMPACT OF DIAMER BASHA DAM

Author: Engr. Riaz Nazir Tarar

Abstract:

Indus Basin of Pakistan possesses world's largest contiguous irrigation system. This was developed on the basis of run-of-river concept, over 100 years or so during the British Colonial Rule. Some further extension of the System on similar basis was also continued over the first 15 or so years after Independence. Under 1960 Indus Waters Treaty three eastern rivers (Sutlej, Beas and Ravi) were ceded to India. However, Indus Basin Replacement Works in Pakistan introduced for the first time the concept of storages (Mangla and Tarbela). This important intervention provided a substantial boost to canal withdrawals of Indus Basin Irrigation System (IBIS). This can be judged from the fact that IBIS average annual withdrawals were: 67 MAF soon after independence (1950); 88 MAF (1960-67) in pre-Mangla period; 95 MAF (1967-77) post-Mangla period; and 105 MAF (1977-82) in post-Tarbela period.

Post-Tarbela developed average canal withdrawals of 105 MAF provided the basis for provincial allocations under 1991 Water Apportionment Accord (WAA). Accordingly, the provinces were given 12 MAF additional allocations over and above 105 MAF post-Tarbela developed canal uses. However, this additionality could be

only achieved through new storage(s), which has not been accomplished so far. On the other hand, due to rapid sedimentation of on-line storages it has not been possible to maintain even post-Tarbela developed uses and in the post-Accord period of 20 years (1994-2013) IBIS faced an average shortage of over 10%. To good fortune of the country, it is now proposed to implement Diamer Basha and Mohmand Dam Projects on fast track basis under directions of the Supreme Court of Pakistan.

While approving the original PC-I Proforma of Diamer Basha Dam Project (DBDP) in 2009, ECNEC constituted a committee to determine utilization pattern of increased water storage capacity as well as additional power generation at the existing downstream facilities. Consequently, a case study was carried out for the Committee by WAPDA. It targeted to meet an overall provincial demand of 121.2 MAF and 3.6 MAF minimum ecological flows downstream Kotri based on derivations from WAA provisions. It assumed integrated operation of Indus River System including the reservoirs.

The case study brought out that significant relief, between 8 to 15%, would be provided by DBDP to IBIS in Rabi season. It will also enable between 4 to 8% increase in minimum ecological flows below Kotri. Additionally, extra generation of about 11% would become available from the downstream existing facilities of Tarbela, Ghazi-Barotha and Chashma. Further estimated power generation increase at the future downstream cascade projects (Dasu, Pattan and Thakot) would be over 50% of generation at the dam site.

Recommendations:

Foregoing case study demonstrated that 6.4 MAF live storage capacity and 4500 MW power installation at Diamer Basha would substantially contribute towards improved water supplies in IBIS and hydropower generation at the downstream facilities as below: -

i. Providing 96 to 100% irrigation service under varying river inflow conditions to meet the targeted demand of 125 MAF against post-Tarbela development of 105 MAF.

ii. Besides at site annual generation of 19000 Gwh, hydropower generation due to cascading effect at the downstream facilities would comprise: -

   a. 2400 Gwh (about 11%) at the existing Tarbela, Ghazi-Barotha and Chashma power facilities.

   b. 10500 Gwh at the upcoming / proposed facilities of Dasu, Pattan and Thahkot.

   c. Above aggregate additionality of about 13000 Gwh would represent about 70% of annual at site generation.

Above figures demonstrate that induction of DBDP will make not only contribute towards alleviation of irrigation water scarcity but substantially boost hydropower generation. Therefore, as per direction of the Chief Justice of Pakistan, priority implementation of DBDP should be taken up without any further delay.

2. Paper: STRATEGIC INTERVENTIONS FOR TACKLING WATER SCARCITY AT THE FARM LEVEL

Author: Muhammad Akram, Hafiz Qaisar Yasin

Abstract:

Water is the strategic resource for developing economies like Pakistan. Agriculture sector uses more than 90 percent of available fresh water supplies as agriculture production is mostly irrigated with over 94 percent of total land equipped with irrigated agriculture (CIAT; WB, 2017). Punjab, the most populous province, is called the breadbasket of Pakistan, which produces 76 percent wheat, 83 percent maize, 64 percent cotton, 51 percent rice, 64 percent sugarcane, 75 percent mango, 97 percent citrus and 80 percent gram of total production of these crops, fruits & pulses in the country (PDS, 2017). The farming is mainly dependent on irrigation with 35.52 million acres (86 percent) under irrigated agriculture out of total cropped area of 41.05 million acres. Water is, therefore, the most critical input for raising crops in the Punjab.

Despite spearheaded significance of water in the Punjab's socio-economic and agriculture development, challenges in the form of water scarcity, prevailing in-efficient irrigation practices, lack of modern irrigation technology, non-existence of water regulations and growing water demands have been remained the major reasons of low irrigation efficiency at the farm level. During last decade, climate change has imposed additional stress on already resource constrained country and put Pakistan in the list of most water insecure countries of the World. It has been estimated that over 50 percent of water is lost during its conveyance and application in the field due to deteriorated farm level irrigation infrastructure and lack of modern irrigation technology (NWP, 2018). There is no incremental water resources development and construction of reservoir since 1980' in Pakistan due to political and institutional issues. Only option for sustained water availability at the farm level has, therefore, been through water conservation measures like rehabilitation of conveyance network through improvement of watercourses, promotion of LASER land leveling, adoption of high efficiency irrigation systems, installation of solar systems for operating drip irrigation systems and promotion of tunnel technology.

Since creation of On Farm Water Management (OFWM) Directorate in 1976, it has undertaken various interventions and projects with the assistance from numerous international financial institutions like World Bank and Asian Development Bank as well as through local funding. These projects have created tangible impact in terms of water saving, improving the conveyance & application efficiency and enhancing the crop productivity under continuously declining water supplies. Improvement of watercourse, for example, results in saving of minimum 119-acre feet of water per annum, reduction in conveyance losses upto 39 percent, increase in crop yield to the extent of 15 percent and in litigation cases by 91 percent. Similarly, LASER land leveling saves about 0.75-acre feet of water per acre, reduces irrigation time by 31 percent and enhances crop yield upto 23 percent. Installation of high efficiency irrigation systems use 50 percent less water, 40 percent less fertilizer and enhances yield upto 100 percent.

Though substantial achievements have been made but at the same time, adoption issues like high capital cost, less operational capacity of the private sector to install high efficiency irrigation systems, change in mindset of farmers to operate these state-of-the-art systems are hindering the fast-track proliferation of these modern systems amongst the farmers. These technologies have pivotal role in the Punjab's irrigated agriculture and their contributions has strongly been recommended in the National Water Policy, National Climate Change Policy and other national policies. Furthermore, Pakistan cannot comply with the UN Sustainable Development Goals (SDGs) and ensure food security without adoption of these technologies under the current climate change scenario.

Recommendations:

In the absence of water resources development, on-farm water conservation activities have shown huge impact at the grassroots level for water, energy and food security, especially under the climate change scenario during last decade. OFWM activities have resulted in very promising results in terms of water saving, enhancing water & crop productivity, reduction in crop production input costs, increase in cropping intensity, crop diversification and significant contribution in the growth of rural economy. Following conclusions and recommendations have been drawn from the analysis of the OFWM interventions.

- Water conservation activities, though, cannot be the replacement of water resources development but these resource conservation technologies have played a major role in sustaining the irrigated agriculture over the years giving hope to the farmers in managing the available resources in the most optimal manner.
- Water availability at the farm level is continuously decreasing and next decade will be very critical. Strenuous efforts would, accordingly, be required for water conservation and ensuring judicious use of available water to save our future generations from water crises. On Farm Water Management (OFWM) activities should be up-scaled under the vison of "**More Crop per Drop of Water**" which is to be achieved through technology driven, sustainable and climate smart agricultural water management with private sector participation to promote high value agriculture for better farm returns.
- OFWM technologies like watercourses improvement, LASER land levelling, high efficiency irrigation systems, solar powered high efficiency irrigation systems and tunnel technology provides an enormous opportunity for water conservation at farm level to meet the food and fibre requirements of future generations.
- Acquired benefits of these resource conservation technologies suggest its adoption on large areas to mitigate the prevailing water, energy and food crisis.
- These OFWM technologies are time-tested, socially acceptable, economically viable and technically feasible options for horizontal expansion of irrigated agriculture by bringing wastelands of Thal, Pothohar and Cholistan under cultivation in coordination.

- Capital cost of these technologies is a major challenge in accelerated adoption of these technologies, especially by the small farmers.
- Government is providing financial assistance for all these technologies, which requires continuity to support farmers in addressing issues of water security and climate change at farm level.
- Active participation of all stakeholders i.e. government, agriculture industry, farmers private sector companies need to collaborate for mobilizing initial investment, its repayments, and follow-up assistance for successful adoption of these technologies by the farmers for sustainability of irrigated agriculture in Punjab.
- Irrigation advisory services for operation and maintenance of these technologies as well as successful crop cultivation with OFWM technologies, especially under HEIS is need of the hour for sustainable irrigation operation and service delivery.
- Although, substantial work has already been done for water conservation at the farm level but still there are sufficient potential in the areas like monitoring and managing of groundwater, developing on-farm water accounting model and ET based water management systems, which have to be emphasised for evidence-based future planning and subsequently its implementation.

3. Paper: STRATEGIC APPROACHES TO DEAL WATER SCARCITY IN PAKISTAN

Author: Dr. Allah Bukhsh Sufi, Muhammad Munir Ch., Maqsood Shafique Qureshi, S. Laraib Zadi

Abstract:

With the increase in population of our country and changing geo-political landscape, the available water resources are fast depleting. We also understand that without water, there can be no life as we see in this physical world. The solution lies in judicious usage of water and realization to preserve, which ultimately leads to superior management of this essential resource. This paper addresses the issues pertaining to water required for agriculture, drinking as well as for other purposes. The measures recommended for preservation of irrigation water include cost effective maintenance of water channels under an integrated mechanism of public-private partnership and ownership through community participation.

Similarly, to resolve the issues related to drinking and general purpose water, a distinction between the two categories has been proposed for putting in practice under an integrated approach. For the purpose of enhancing storage capacity, instead of fighting on the construction of much awaited mega dams, the paper suggests construction of small dams and run of the water channels auto-spillover bunds are short term solutions. However, construction of mega reservoirs is also necessary to cope with water needs. These measures, apart from being cost effective (i.e. affordable) shall have no political controversies. The concept is storage

of water through spread over river beds and storage sites. The paper also suggests measures for creating awareness among our people to make judicious use of water.

However, due to some controversial issues and short funds availability, it has not been possible to undertake construction of new storage dams, to meet with the urgent national need for additional storage capacity, especially on river Indus is to be taken on fast track. The construction of additional dams would not only augment irrigation supplies, but also mitigate floods, besides increase in power generation, employment opportunities and economic boost. Our underground water resources are being over exploited. Increase in sustainable water resources in the country can be achieved through a combination of exploring valuable groundwater aquifers and constructing potential large, medium and small surface water storages and through water conservation strategies. The combination of surface and groundwater has become critical in meeting the water needs of the 21st century in the country.

Recommendations:

- Campaign on efficient use of water in domestic, industrial and agricultural sectors have been launched to disseminate knowledge and information to the water users especially farmers by Planning Commission through Chief Engineering Advisor provincial OFWM Departments.
- Rain water harvesting of 3 MAF to irrigate 12.85 million acres and use of treated water is also being adopted at small scale. Water is key factor for agro-socio-economic uplift in the country.
- Additional storages and other relevant water management developments of efficient water use in the country would not only be able to sustain food security. But if properly managed, it would be possible to enable the country to export more agricultural products to sustain the economy, besides flood management and employment opportunities.

4. Paper: WATER SCARCITY AND FUTURE OPTIONS IN PAKISTAN

Author: Engr. Dr. Muhammad Nawaz Bhutta

Abstract:

Pakistan is already one of the most water-stressed countries of the world, a situation which is going to deteriorate into outright water scarcity due to large and expanding population. Water for agriculture will progressively become scarcer due to persistent increases in the competing demand for drinking water, industry and environment. Salt balance in irrigated lands is negative. More salt is being added in the Indus Basin than the quantity of salt that is getting out of the Basin. With the passage of time the soil quality will further deteriorate, and crop yields could be seriously affected. For maintaining a favorable salt balance in the root zone of crops, 20% water additional to the crop requirement is needed to flush the salts on continuous basis. Pakistan is fast losing storage capacity of Tarbela, Mangla and Chashma due to siltation. Climate changes, intensifying droughts and floods will have the combined effect of deepening the crisis. The snowfall will occur for a shorter duration and melting will continue for longer period. Snowmelt and supply of water will be

available much earlier than the present (prior to Kharif sowing) and may be inadequate for Rabi sowing. Many small glaciers may disappear. With the rise in temperature as a result of climate change, crops will require more water due to excessive evaporation, cattle will consume more water and domestic water consumption would also increase.

Water is crucial for food production. Water scarcity will lead to food scarcity which is a radically different threat because it affects the poor so profoundly. It has been the cause of riots and revolutions. Imported food cannot be relied upon as the era of cheap food is over. It is easier to store water for drought years than store food for such events. Luckily we have water to store and we have sites to store water. Investing in water reservoirs is a key step towards ensuring food security. By far the most effective way of tapering flood peaks and minimizing flood damages and loss of life is flood control through storage reservoirs. To mitigate impact of droughts, it is necessary to build large dams having carry over capacity from wet years to dry years, to build small and medium size dams for local and regional uses and to recharge aquifer. Large dams not only increase the assurance of water availability, but they can also generate large amount of electricity which is vital for development of industrial, agricultural and service sectors. Projects ranking highest in technical, economic and environmental viability should be preferred irrespective of any other consideration. The benefits of existing storages are so well demonstrated that all the provinces keenly contest of every cusec of stored water in the existing reservoirs.

To overcome water and power scarcity, and as a short term measure it is recommended that immediate construction work should be started on another large Dam concurrently with Diamer-Bhasha. Long term plan for storing additional 50 MAF (for meeting farmgate requirement of 40MAF by year 2050) water needs to be prepared and implemented starting with the top ranked project.

Recommendations:

The following action plan is proposed for the augmentation of water resources in Pakistan.

- As a short-term measure, work on another large dam having hydropower potential should be started concurrently with Diamer Bhasha Dam Project.
- A long-term plan for storing additional 50 MAF upto year 2050, needs to be prepared and a ranking system devised to prioritize projects for implementation.
- An awareness campaign about the needs and benefits of water reservoirs needs to be launched immediately.
- Rainwater harvesting and groundwater recharge plans be prepared and initiated.
- Steps to be taken to protect water from pollution due to sewage and industrial waste.
- Sprinklers and drip irrigation shall be introduced at feasible locations.

5. **Paper: WATER CRISIS, IMPACTS AND MANAGEMENT: PAKISTAN'S PERSPECTIVE**

Author: Professor Dr. Imran Hashmi, Romana Khan

Abstract:

Amid the current scenario of water crisis globally, it becomes an indisputable fact that improving the current detrimental impacts of its scarcity and providing solutions along with the management of left-over resource has become the need of an hour. Pakistan which stands third among countries facing acute water shortage is already bearing the impacts of its scarcity. Demand for water resources is increasing greatly in Pakistan however; per person water availability has fallen below the 1000 cubic meter. This alarming figure is going to be more deleterious in the coming days as Pakistan is predicted to be on its way to becoming the most water-stressed country in the region by the year 2040. Therefore, Water crisis is becoming an evident factor by every passing day whilst an emerging issue of concern at present. Noticeably in Pakistan no less than 38.5 million Pakistani's lack access to safe drinking water the figure has been quoted by the Pakistan Institute of Development Economics.

Besides humans, the perforating impacts of water crisis on the plants, animals, soil and weather will obliterate the whole economy. Reports by the United Nations Development Programme (UNDP) and the Pakistan Council of Research in Water Resources (PCRWR) also warn the authorities that the South Asian country will reach absolute water scarcity by 2025. Pakistan's major water consumption sector is agriculture with approximately 96 % water demand. Given the growing concerns about water availability in Pakistan now it's time to think about solutions that will help to reduce water shortages other than constructing huge dams and reservoirs that appear ineffective in current social and political context. For the beneficial management of the resource the country ought to show more dependency on the technology it should move towards the reuse of its resource through proper planning so that the impacts can be eradicated out for the welfare of the nation. Moreover, numerous steps need to be taken at the international as well as national level in collaboration with the grass root personnel to reduce the impacts of water crisis.

Recommendations:

Pakistan is going through the worst water scarcity of history. Therefore, implementation of the recommendations will enable the country to meet the challenges, and attain the objectives of efficient, integrated, environmentally and economically sustainable development and management of limited water resources. Conservation of groundwater aquifers as well as more resourceful use of freshwater derived from rivers is the only way to guarantee that the terrible projection of disastrous regional water wars does not materialize. The solution of prevailing water shortage requires national consensus over proposed projects and their implementation in letter and spirit. At the same time, it will allow us to utilize every drop of our water for our bright future.

In order to succinct the whole discussion it is evident to say that water crisis is the most difficult obstacle of the 21st century and it is the need of an hour to deal it with iron hands. Water is the most abundant natural resource on the surface of the earth and in the light of this known fact people are exploiting this resource. Due to this

exploitation water becomes scarce and it lays huge burden on the socio-economic, political and ecological factor of the earth. Therefore, it is substantial for the national and international management to take essential steps at the right time before the earth take its step to imbibe the whole human being.

6. Paper: WATER STEWARDSHIP-AN INTEGRATED WATER MANAGEMENT APPROACH FOR THE INDUS BASIN

Author: Mr. Sohail Ali Naqvi, Dr. Masood Arshad

Abstract:

Pakistan is a water scarce country. Additionally, environmental issues such as climate change, reduced agriculture productivity and compromised water quantity and quality are negatively affecting our food chain. In the past, there have been multiple initiatives by the Government, Private sector and Civil Society Organizations in the water sector, but the approach was usually limited in nature or non-inclusive in terms of stakeholder involvement. WWF-Pakistan introduced a concept of water stewardship and tried to bring stakeholders at one platform. This paper reviews the basic concept of Integrated Water Resource Management (IWRM) and how the Water Stewardship approach integrates into IWRM. Furthermore, this paper will also share few examples of successful Water Stewardship through ongoing projects at WWF-Pakistan such as Basin Assessment Scenario Intervention Tool (BASIT), International Labour & Environmental Standards (ILES), Alliance for Water Stewardship, Revitalization of Ravi River and City- Wide Partnership.

Recommendations:

Conclusively, WWF-Pakistan is striving to redefine the role of the private sector in promoting better basin management and governance in the Indus Basin for the benefit of people and nature. Through various projects and platforms, WWF-Pakistan tries to bring all stakeholders on one platform to propagate the concept of Water Stewardship where stakeholders identify that water risks are shared, and the true solution lies in united efforts and combined strategies. Stewardship is a tool which compels you to think in a different way as compared to a conventional thinking on water resources and these approaches are now-a-days getting success globally. In Pakistan we need to promote water stewardship approach to take stakeholders at one forum (from research to water practitioners and policy makers to decision makers) then we can claim right IWRM approach is key to success. There is also need to think in a different way on the valuing the river water.

7. Paper: CLIMATE CHANGE, SCARCITY OF WATER/ENERGY IN PAKISTAN AND SOLUTIONS THROUGH EDUCATION, CLEAN ENERGY, FLOODPLAINS / SEWERAGE REGULATIONS / MANAGEMENT

Author: Engr. Abdul Qayyum

Abstract:

The continuously growing water stressing / scarcity due to global warming impacts, are already observed/experienced, throughout the world, leading to a situation in

which available, inter alia, water resources are depleting and/or deteriorating, unable to satisfy the basic needs. Pakistan, especially, being far away from requisite measures/awareness, e.g. special requisite emphasis/focus on clean water/renewable energy, has entered in the group of countries that are now moving from the state of water stressing to water scarcity, involving toxins extremely injurious, both to human and wild/aquatic life.

High population growth, increasing urbanization without any regard of the impacts of climate change (e.g. ignoring the need/importance of rainwater-harvesting/floodplains to recharge/ replenishing aquifers), inefficient irrigation practices, indefensible water uses and their fragmented management, especially unacceptable sewerage system and absence of proper evaluation of floods / floodplains against the adverse effects of anticipated climate change and the requisite regulations / their implementations, in the light of flood Management rules, are placing enormous pressure on surface / ground water resources and recreation facilities all over Pakistan.

Untreated waste water, both domestic and industrial, when enters in adjacent nullahs, streams, canals and/or rivers, heavily pollutes all type of recipients. The dual problems of clean water shortage and untreated waste water overflow triggered with anticipated effects of climate change are serious, present and future, threats to Pakistan and needs serious attention for its solution on top priority / urgently in a strategic / synchronized manner. Presently almost all surface / ground water in Pakistan are polluted with E. coli and Arsenic, causing different deceases. More over the quantity of dissolved oxygen (DO) in river waters, especially when passing through towns / cities, has reduced to a prohibitive limit. Being the member of the United Nation's Framework Convention on Climate Change (UNFCCC) and after passing the climate change Act-2017, Pakistan, as responsible member to save the planet, should use its indigenous resources, which exist in abundance, of renewable energy with measurable progress and clear targets/deadlines.

This in turn will help in achieving the priority thematic areas/goals of climate change, while making Pakistan one of the economical leaders in the world and ensure the prosperity of the people in environmentally sustainable conditions. Hope the conclusions / recommendations, submitted via this paper will form a basis of policy dictating /consideration.

Recommendations:

Responding to climate change is a generational journey, the sooner and faster Pakistan acts the greater chance of Pakistani people of arriving at the future, they indeed need. Therefore, to meet the target following recommendations are made;

i. **Education;**

   Like other countries, the activities mentioned about climate change effect may be started in Pakistan through education and news, so that the general people/society gets requisite awareness/relevant-actions regarding climate change and its impacts.

ii. UNFCCC's the first two Priorities thematic areas are Renewable Energy and Energy efficiency while almost all countries, except Pakistan, have set with measurable progress and clear deadlines, their

goals for the inclusion of renewable energy with means of efficiency in their national grid-systems. Indigenous means/resources (Solar, Wind, geothermal, pumped storage) of clean energy are available in Pakistan.

Some very highly qualified and competent group(s) of consultants be engaged to carry out comprehensive studies in the overall perspective of available; Hydro (conventional + pumped storage), wind, solar and geothermal energy potential, system conditions and country's future demand with measurable progress of renewable energy/efficiency means and clear deadlines as how/when the total potential can be exploited, so that Pakistan is able to fulfill its obligations, as member of UNFCCC, promised in 1994 and again confirmed via Climate ACT 2017. This in turn will improve the economy of Pakistan, ensuring the prosperity of the people of Pakistan; rather it can become the battery of economic growth in Pakistan.

iii. Pakistan, like United Nations' Millennium Declaration, should adopt/formulize some mechanism so that vulnerability of the existing water-supply/sewerage system is determined and then adaptation to water supply and sanitation under the UNFCCC program, for existing and future requirements, is carried out in a measurable progress with clear deadlines. It will improve the ecosystem in Pakistan.

iv. One of the most adverse effects of the climate change is the occurrence of exceptional high floods, therefore it is recommended that:

Adequate valuation of floods, legislation regarding Floodplain Regulations and then its implementation on urgent basis in all over Floodplains, including the three (03) western rives, of Pakistan is recommended on urgent basis. If formulated and enforced, then Flood Plains are to be used under proper Flood Regulations followed by flood management and can provide best measures of recreation/ environment to local people and can cause guaranteed protection which can reduce poverty and improve quality of life thereby associated with reducing the vulnerability of the people. It, in a scientific/safe way, will fulfill Pakistan's promise, made through Climate Act-2017 to UNFCCC, of making green Pakistan.

v. Rainwater Harvesting: While developing rural/urban areas, due provisions should be made for rainwater harvesting. It, inter alia, will help in charging the aquifers with clean water.

vi. The impacts of climate change inter alia include sea level rise and sinking of the coastal areas (Karachi etc.), therefore proper/investigations arrangements are recommended.

8. Paper: WATER SCARCITY COPING WITH INTEGRATED WATER RESOURCES MANAGEMENT IN PAKISTAN

Author: Engr. Dr. Muhammad Saeed, Engr. Muhammad Shoaib

Abstract:

The increasing scarcity of water in dry areas is now a well-recognized problem. According to the World Commission on Environment and Development, approximately 80 countries with 40% of the world population already suffer from serious water shortages. At present, water shortages have led most of arid and semi-arid countries to increase food imports because the local agricultural sector is not able to produce sufficient food to fill the existing food gaps. The increasing food gaps are posing serious challenges beyond the economic and political capacity required for the necessary adjustments concerning the allocation and use of water in all sectors, particularly agriculture.

Integrated Water Resources Management (IWRM) is the practice of making decisions and taking actions while considering multiple viewpoints - how water should be managed? These decisions and actions relate to situations such as river basin planning, organization of task forces, planning of new capital facilities, controlling reservoir releases, regulating flood plains, and developing new laws and regulations. The need for multiple viewpoints is caused by competition for water and by complex institutional constraints. The decision-making process is often lengthy and involves many stakeholders.

The agricultural sector is by far the largest user of water in the world. On a consumptive use basis, 80–90% of all the water is consumed in agriculture. Unfortunately, water use efficiency in this sector is very poor not exceeding 45% with more than 50% water losses; thereby, enormous water saving could be achieved in the agricultural sector comparable with other sectoral water uses. The growing water scarcity and the misuse and management of the available water resources are nowadays major threats to sustainable development for the various sectors, especially domestic, industrial and agricultural.

To integrate the available water in the system management of water resources and its utilization, a series of dams are needed, in a way that river flows are tamed in steps and reservoirs are managed as a cascade. The integrated water resources management includes harvesting the rain water by developing small and medium dams on hill torrents and by adopting techniques of ground water recharging so as to mitigate effects of extensive pumpage. The IWRM at all levels and its use is earnestly needed. The water resource potential on western rivers is to be exploited, and there are number of projects, which are at different stages of planning and execution by WAPDA to harness the western river flows to meet the irrigation and power requirements of the nation.

Recommendations:

The Indus Basin Irrigation System reflects a situation in which the primary resource constraint on agriculture production is water. Pakistan has very little water storage capacity and can barely store 30-40 days of water in the Indus Basin. When river flow is variable, then storage is required in order to match the water demands.

Growing shortfall in water availability compared to demand will continuously increase in future at the basin level. Holistic policies for water resources development and management are required to sustain growth in the context of resource limitation. Development of 15 to 20 MAF of water storage and interventions for improving water availability through water conservation are imperative.

Pakistan water resource sector has to be developed and make significant investments. There is a need of further intensification of canal water supply and land development to meet the future needs of population growth. The conjunctive surface and groundwater management would require water from additional storage reservoirs, and to have alternative water management regulatory framework/institutional setup and use of new technologies in irrigation to improve water productivity.

- **Integrated Water Resources Management (IWRM)**

  Integrated water resources management (IWRM) has been defined by the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".

  In the Indus basin the main issue is water shortage, to solve the issue, IWRM techniques must be adopted. The lack of water does not allow industrial, urban and tourism development to proceed without restriction on water uses and allocation policies for other user sectors, particularly agriculture. Poverty associated with water scarcity generates migratory fluxes of populations within countries or to other countries where people hope to have a better life, but where they may not be well received.

  Strengthening IWRM and water management capacity is needed to deal with both the existing and emerging water challenges taking into account the issues like climatic changes, groundwater use, water quality, pollution, urbanization and industrialization, licensing access to water etc. A continuum for decision making in water resources management is to be prepared, identifying the fundamentals of IWRM implementation by addressing the resource condition and allocation issues at the basin level.

- **High Efficiency Irrigation Systems**

  Current irrigation practices are inefficient and water productivity is lowest in the Indus basin irrigated agriculture. The development of laser levelling technology and furrow-bed irrigation has resulted in saving 30 percent of water and has led to an increase in productivity by 25 percent in the district of Okara, Punjab. Such a model should be replicated in other areas as well. Likewise, the establishment of drip irrigation farming systems, a type of high value farming as a mix of creeper-type vegetables and high-density orchards in areas outside the Indus Basin where water is at premium, should be adopted by farmers.

- **Groundwater Management**

  At present, the water demand of agriculture, livestock, rural and urban households, industry and non-agriculture infrastructure has gone far beyond the originally planned surface water supply. The population growth and urbanization are two important factors upsetting the self-sufficient rural canal colony model (The Canal and Drainage Act 1873). In this context, the use of groundwater tremendously increased facing an increasing danger of depletion and quality deterioration. The agriculture sector is the major user of groundwater. The conjunctive use of canal and groundwater does not have corresponding planning and management at the command area level. Groundwater has become a vital and major part of the overall water resources in the Indus Basin irrigation system.

  The groundwater use is however reaching to the sustainable limits. The fast growing cities and industries looking for large increases in water supply are adding to the challenge. An effective monitoring and management system that encourages the private management sustainability of this water source is needed. Punjab must intensify its efforts to put in place an effective framework for groundwater management. The experience in this regard suggest to follow a phased and incremental implementation strategy with initial focus on groundwater monitoring and gradual shift to groundwater management in a phased manner. The awareness raising campaign is also very important for sensitizing the stakeholders about groundwater issues, self-regulation and groundwater monitoring and management interventions. It is relevant to point out that the upcoming institution of Farmers Organizations can play an effective role for management of groundwater in their respective areas.

- **Institutional and Policy Reforms**

  In water sector, the role of Government is coordination and policy formulation. Indus River System Authority (IRSA) coordinates and oversees the distribution of water of the Indus and its tributaries among provinces. Any proposed development in the water sector has to be reviewed by IRSA to ensure conformity to the Water Accord. Implementations of agriculture and irrigation activities were mostly non-collaborative with a very little interaction among respective stakeholders. There is no overall single agency, which is responsible for coordinating water resources development as well as approving inter-sectoral water allocations either at federal or provincial level. A comprehensive strategy and a framework for the water sector is required within which competing demand for water and scarce financial resources can be assessed and service delivery improved. Holistic institutional and policy reforms to improve the management and maintenance of the Indus Basin Irrigation System to ensure its long-term physical and financial sustainability, water resources management reforms to make inter-intra-province water allocation and distribution more transparent, service delivery reforms to improve the quality efficiency and accountability and reforms to improve water use efficiency and on-farm productivity are required.

- **Increase Public Awareness**

  Water has been highly politicized in Pakistan and there is an extreme deficit of trust among the provinces. This deficit of trust is largely due to a lack of access to data and information. Popular papers need to be prepared along with posters and stickers for creating mass awareness. The use of mass media in creating awareness at all levels, including civil society at large, is also integral. Without awareness, water cannot be made as 'business for everyone'.

9. Paper: NATIONAL WATER POLICY – A MILESTONE TO ADDRESS WATER SCARCITY IN PAKISTAN

Author: Dr. Qazi Tallat Mahmood Siddiqui

Abstract:

Pakistan has one of the largest contiguous irrigated systems in the World. The snow-clad peaks of the mountain ranges in the North continuously re-charge the system. The descending snow-melt and monsoon waters flow into the country's Indus River System and its tributaries. Passing through the plateau and the great plains across the Indus Valley, the rivers join up to form the Indus that eventually drains into the Arabian Sea in the South. Irrigated agriculture is the backbone of the country's economy, and consumes around 95 percent of the nation's water resources, the balance is used for domestic and industrial requirements. With rapidly growing population, Pakistan is heading towards a situation of water shortage and by corollary, a threat of food insecurity. Per capita surface water availability has declined from 5,260 cubic meters per year in 1951 to around 1,000 cubic meters in 2016. This quantity is likely to further drop to about 860 cubic meters by 2025 marking our transition from a "*water stressed"* to a *"water scarce"* country .The situation calls for rapid development and management of the country's water resources on a war footing.

Water resources are inextricably linked with climate and the impending climate change scenario has serious implications for Pakistan's water resources. The continuing increase in population at an annual rate of over 2% combined with rapid and un-regulated urbanization has already pushed Pakistan into the category of water stressed countries. The changing and unpredictable precipitation patterns may have serious consequences, including flash floods in the north and increasingly prolonged droughts in the south. As the glaciers retreat, more glacial lakes will form, increasing the risk of Glacial Lake Outburst Floods (GLOF), which are already becoming increasingly common and hazardous in the Northern parts of the country. Only by devising and implementing appropriate adaptation measures will it be possible to ensure water, food and energy security for the country as well as minimize the impact of natural disasters.

The objective of the National Water Policy is to take cognizance of the emerging water crisis and provide an overall policy framework and guidelines for a comprehensive plan of action. Pakistan has a federal system of government and the provinces enjoy a considerable degree of autonomy under the 18thAmendment to

the Constitution. Thus, this policy is a national framework within which the provinces can develop their master plans for sustainable development and management of water resources. The water resource is a national responsibility but irrigation and agriculture, as well as rural and urban water supply, environment and other water related sub-sectors are provincial subjects. NWP is an enabling document and provides comprehensive guidelines for water resources management and development as per international practice. It also contains a development action plan till 2030. NWP will pave way for improved, sustainable and integrated water resources management in the country to combat the water scarcity in the future.

Recommendations:

Subsequent to approval of NWP, a national body named as "National Water Council" (NWC) has been established under chairmanship of the Prime Minister of Pakistan with Federal Minister for Water Resources, Federal Minister for Finance, Federal Minister for Power, Federal Minister for Planning, Development & Reform and Provincial Chief Ministers as members. The prime function of the NWC shall be to oversee the implementation of the Policy and issue directions where appropriate. A Steering Committee has also been notified to oversee and monitor the policy implementation guidelines given by the NWC through Policy Implementation Cell. The Steering Committee shall be headed by the Federal Minister for Water Resources with representatives from federal and provincial governments and concerned organizations. The Steering Committee shall have its meeting twice in a year or whenever deemed necessary .The draft NWP is an enabling document and provides comprehensive guidelines for water resources management and development as per international practice. It also contains a development action plan till 2030. It is strongly believed that NWP will pave way for improved sustainable and integrated water resources management in the country.

10. Paper: GROUNDWATER REGULATION FOR INTEGRATED WATER RESOURCES MANAGEMENT IN PUNJAB

Author: Mr. Ghulam Zakir Hassan Sial, Saleem Akhtar, Ghulam Shabir, Faiz Raza Hassan

Abstract:

Groundwater over-exploitation poses a severe threat to food, water and livelihood security in Pakistan, but the approach to groundwater regulation has been guided by the simplest prescription that to achieve sustainable use, pumping must be less than recharge. This article explains the hydrological cycle and the close relationship between groundwater and surface water and argues that the conventional notion of sustainable groundwater use is fundamentally flawed. Groundwater, soil moisture and surface water are part of a single integrated resource and cannot be regulated independent of each other. The solution is not sustainable use or the compartmentalization of surface and groundwater but the fair and transparent reallocation of renewable freshwater resources. Although groundwater has improved the livelihood of rural farming communities and has contributed significantly towards national economy, yet at present situation is very alarming indicating serious sustainability concern for food and energy crisis in the Province.

Punjab Irrigation Department has installed and monitoring groundwater levels from about 3000 piezometers in canal commanded areas in the province. A groundwater management cell has been established for carrying out research studies. Development of draft "The Punjab Groundwater (Protection, Regulation and Development) Act 2018" and "Punjab Water Policy 2018" are two steps for groundwater regulation and management in the Province. Abnormal lowering of water table in sweet groundwater areas, inter-mixing of saline and fresh groundwater, more energy requirements with declining water levels, deterioration of quality, threats to agriculture due to secondary salinization etc. are the major consequences of ill- planning and over exploitation of groundwater reservoir.

Recommendations:

- Existing rules and regulations on groundwater water resources should be reviewed in order to improve and streamline their scope to cover aspects pertaining to groundwater resources management, protection of quality, prevention of pollution, penalties for undesirable effluent discharges, licensing, abstraction, and ownership.
- The legislation should be comprehensive, integrated and should be framed in the simplest way possible and be consistent with the need to spell out the respective responsibilities and powers of governmental agencies and the means for conferring rights to use water on individuals.
- The legislation should allow for the easy implementation of policy decisions, which should be made in the public interest while protecting the reasonable interests of individuals.
- The legislation should define the rules of public ownership of water projects, as well as the rights, obligations, and responsibilities, and should emphasize the role of public bodies at the proper administrative level in controlling both the quantity and quality of water. It should also spell out, either in the primary or subordinate legislation, administrative procedures necessary for the coordinated, equitable, and efficient control and administration of all aspects of water resources and land use problems, as well as the conflicts that may arise from them.
- The legislation should take into account the institutional capacity building to implement it.
- There should be necessary efforts for effective participation in the planning and decision-making process involving all stakeholders and there should be a continuous two-way flow of information.
- In the field of community, groundwater management, special emphasis should be given to the role of women.
- For promoting better management of groundwater demand and encouraging better use of available resources, water tariff policies should be evaluated in accordance with the general development policies so that they may be effectively used as policy instruments.

- Responsibilities of each of the federal and provincial governments may be clarified over water resources management

11. Paper: WATER CONTAMINATION AS A MAIN SOURCE OF WATER SCARCITY IN PAKISTAN

Author: Dr. Abdullah Yasar, Burera Khushbakht, Mahnoor Iftikhar, Dr. Amtul Bari Tabinda, Naveed Anwar, Dr. Mujtaba Baqir

Abstract:

In Pakistan the ground water is one of the major sources of water consumption and it is also a valuable resource, but due to landfill leachate, uncontrolled hazardous waste sites, freeway disposal of wastewater from industries and agriculture causes the pollution of natural water resource. The research shows that Arsenic and Fluorine are two major pollutants in groundwater of Pakistan and more than 50% of groundwater wells have their increase concentrations even it exceeds from the permissible WHO limits results in water shortage and various health related problems like anemia, gastrointestinal irritation, lung infections, hepatitis, intestinal infections and diarrhea, dysentery, cholera, respiratory paralysis, typhoid fever, jaundice and skin diseases in children as well as in older and younger adults.

This review sums up the outcomes of various research studies conducted for groundwater quality status and water shortage in Pakistan. The scarcity of safe and healthy water sources causes 20% of the population to use clean water, but the rest of 80% population has no access to safe water. The study shows that there is an immediate need of taking measures to control groundwater contamination and water scarcity such as management of waste, use water wisely, reduce, reuse, recycle, use fewer chemicals, plant more trees and spread awareness about water contamination and water scarcity.

Recommendations:

In Pakistan the drinking water is not safe for human consumption because the pollutant contents are in increase concentration even they exceed from permissible quality standards. The heavy metals concentration is also increasing from standards and limits set by WHO (World Health Organization). The most common heavy metals are Chromium, Iron, Cadmium, Nickel and Arsenic. Fluoride and Nitrates are also a threat in some parts as fluoride in some areas is very low whereas in some parts it is very high. The main source of water pollution is uncontrolled municipal waste and untreated industrial wastes. In rural areas the monitoring of water quality is totally absent (Aziz; 2005). The water disinfection practices like chlorination is either unsatisfactory or nonexistent. This causes serious human related problems.

Waterborne disease is the main issue caused by the chemical and bacteriological pollution of public drinking water. The insufficient record of water related diseases and the lack of diagnostic technology contributed to the blur picture of water linked diseases result in poor handling of these diseases.

There are various recommendations to the problem of deteriorating water quality:

1. The proper monitory procedures should be introduced in every part of the country.
2. Purification of water should be made mandatory by local authorities.
3. The continuous water supply should be compulsory in order to avoid intermittent contamination and to fulfill the water needs.
4. The sewage pipelines should be away from water supply.
5. It should be made compulsory for industries to install waste water treatment plants. The industrial water should be monitored regularly.
6. The pesticides should be treated safely. The farmers should provide regular education and awareness about the use and disposal of pesticides.
7. There should be guidance for storage of water inside the houses.
8. There is a strong need of implementation of strict laws.
9. The old rusty water supply lines should be treated regularly.
10. There is a need for proper sewage handling in urban areas of Pakistan. (Azizullah;2011)

KEY RECOMMENDATIONS
WORLD WATER DAY 2019
ON THE THEME OF
"LEAVING NO ONE BEHIND"
Saturday, March 30, 2019

1. STUDY QUANTUM OF TRANSBOUNDARY GROUNDWATER FLOW FROM INDIA TO PAKISTAN

By

Author: Engr. Dr. Muhammad Basharat, Engr. Muhammad Jawad, Engr. Dr. Muhammad Saeed and Engr. Muhammad Shoaib

ABSTRACT:

The Government of Pakistan and the Government of India were equally desirous for attaining the most complete and satisfactory utilization of the water of the Indus River System. Therefore, in a spirit of goodwill and friendship, a treaty was pledged in 1960 between these two countries, called Indus Water Treaty (IWT), 1960. According to this treaty India was given exclusive rights on three eastern rivers Ravi, Beas and Sutlej. The whole IWT deals with surface water including rivers and surface drains entering from India to Pakistan. Groundwater recharge being function of surface water were not discussed or are not the part of the treaty.

The groundwater data was collected from Monitoring Organizations of both the countries and groundwater elevation contours were generated using GIS. Results revealed that the flow of groundwater has its gradient towards Pakistan in some areas and in some other areas the flow direction was found parallel to India-Pakistan Border following (NE to SW) in the direction of flow of surface water.

CONCLUSIONS

Following are the conclusions drawn from this research:

- IWT 1960, involved only the surface water of Indian Sub-Continent and their distribution. However, the recharge of Groundwater is an important parameter which is the function of surface water flow and neglected in the treaty.
- It was found that, throughout the Indo-Pakistan border there is no such section where there was gradient of groundwater flow towards India. Rather, at two critical sections i.e. at section 2 and Section 4, the flow gradient is towards Pakistan. As a result, 0.0132 MAF/annum water is moving from India to Pakistan, where the groundwater elevation in India being at higher level than Pakistan.
- Moreover, increased pumping trends in Pakistan, mostly in Bari Doab area, also adding to it. In the other critical sections along Indo-Pak border the flow of groundwater is along the border following NE to SW direction at some places

and N to S in other areas. Groundwater mining in Indian Punjab and Rajasthan areas is away from border, which is the effect of high rate of groundwater pumping in the populated areas for domestic and agricultural purposes.

- There are four eastern drains entering from Indian side, as mentioned in IWT. Out of all these drains Hudiara Drain carries more pollutants. A study was carried out on the pollution of Hudiara by Afzal S. *et al.* (2000). The results showed that COD, BOD and TSS were not in the permissible limit as defined by NEQS.
- In total the average annual volume of drainage effluent entering from Indian side to Pakistan in Hudiara Drain was calculated as 0.13 MAF/year containing 354 ppm Total Suspended Solids in drain water which becomes 57416Mg/year.
- After entering in Pakistan, a lot of small drains and one major drain Satukatla Drain outfalls in Hudiara Drain, unless Hudiara Drain discharges its water in Ravi River amounting to average volume of 0.36 MAF/year. The water of Hudiara mixes with Ravi River water which is then used for irrigation purpose through irrigation canals in area of Bari Doab.

RECOMMENDATIONS

Following are the recommendations of this paper regarding Transboundary groundwater drainage from India.

- Minimum water should be released in the eastern rivers i.e. in the Ravi, the Beas and the Sutlej, also called environmental flows round the year in order to recharge aquifer underneath to minimize the groundwater depletion in Bari Doab area which is not mentioned in IWT.
- National Water Policy of Pakistan, March-2018 recently approved by Government of Pakistan should be strictly implemented
- India must release its industrial and domestic effluent in Hudiara Drain and all other three drains after treatment, so that it may neither contaminate groundwater of Pakistan nor it disturb the Environment related parameters.

2. A BILEVEL MULTIOBJECTIVE PROGRAM FOR OPTIMAL ALLOCATION OF WATER RESOURCES IN THE COMMAND AREA OF TAUNSA BARRAGE

Author: Muddasar Masood, Ijaz Ahmad, Noor Muhammad Khan,

Terminology:
A.W = Available Water
N.E.B = Net Economic Benefits
S.R = Satisfaction Rate

Abstract

Water is the basic requirement of all living thing. Water demands of various users have been increasing at an alarming rate due to the rapid population growth and industrialization which leads to conflicts among different water users. To overcome this issue optimal water allocation is required, so that each user is satisfied with allocation of the limited available water and maximum benefits can be obtained by the use of water. Therefore, in this study a bi-level multiobjective model based on linear programming for optimal allocation of limited available water among different users is formulated and applied at Taunsa barrage. The model allocates available water based on equity at upper level among different canals and on lower level based on satisfaction rate, net economic benefits among different crops. Benefits obtained by wheat, cotton, sugarcane, rice, onion, sunflower crops in optimized allocation are 2010, 704, 3214, 3899, 187 and 19 million rupees, respectively. The results indicate that the performance of model is satisfactory, and it optimally allocates the available water.

Conclusion

In this study a bi-level multiobjective optimization model is developed and applied to a case study at Taunsa barrage. From the historical data, it was found that water availability is very less compared to demand in that area. So, to allocate the limited AW, multiobjective model is used that maximize overall SR and NEB obtained by using canal water. In case of OF_1 SR of 61% was achieved which is maximum possible SR by using the AW. In case of OF_2 NEB of 10770 million rupees is achieved which is maximum possible NEB. In case of OF_{12} NEB of 10034 million rupees was obtained against SR of 52%. In case of OF_{12} both NEB and SR obtained lies between individual objective functions, so, model performance is considered satisfactory. In case of optimized allocation, wheat, cotton, sugarcane, rice, onion, sunflower corps are allocated 341, 303, 869, 866, 12 and 24 MCM water, respectively and these crops obtained NEB of 2010, 704, 3214, 3899, 187 and 19 million rupees respectively.

3. NATURAL BASED SOLUTIONS TO WATER CHALLEGES FOR PAKISTAN

Author: M. Munir Ch., M. S Qureshi, Dr. A. B Sufi and S. Laraib Zaidi

SUMMARY

The nature plays a vital role in water resources extent and quantity especially for agricultural economies and development as a whole in every walk of life. The 4th Assessment Report (AR4) by the three working groups of the Intergovernmental Panel on Climate Change (IPCC) has projected that average global surface temperature will increase by approximately over 4°C by the 21st century. The recent annual average temperatures for Northern and Southern Pakistan are about 19°C and 24°C respectively. The glaciers constitute about 2,700 km^3 of stored volume of ice (Roohi, 2005), equivalent to about 14 years of average Indus River System inflows. The thermal regime of Hindu Kush Himalayan (HKH) glaciating region has in general warmed up and the frequency of occurrence of moderate as well as severe heat waves have also increased significantly.

The climatic change in Pakistan has slowed down melting of glaciers and snow from mountains due to low temperatures in recent years in northern area, thus reducing flow of rivers resulting in severe water shortages during winter. However, temperature in the northern glaciating area is again rising since 2014-2015. Based on the studies available, it looks likely that the HKH glaciers are receding under the influence of global warming and their melting will increase with increase in summer temperatures. Recent simulation modeling conducted by Global Change Impact Studies Center (GCISC), Geneva, Switzerland, on Indus flows for a scenario where temperature will rise by 4°C and glaciers would shrink to half of their present size, indicates that overall annual river flows would reduce by about 15% and the monthly flow pattern would also change considerably, with more water coming in spring and early summer and less water in the later part of summer.

The extremes of nature are never feasible for water resource. Only a favorable climate is a source of balanced development. It is pertinent to explore that how we can use nature to overcome the water challenges of the 21st century. Environmental damage along with climate change, are driving the water-related crises we see around the world. Floods, drought and water pollution are all made worse by degraded vegetation, soil, rivers and lakes. When we neglect our ecosystems, we make it harder to provide everyone with the water we need to survive. Nature-based solutions have the potential to solve many of our water challenges. We need to do so much more with ‘green’ infrastructure and harmonize it with ‘grey’ infrastructure wherever possible. Planting new forests, reconnecting rivers to floodplains, and restoring wetlands will rebalance the water cycle and improve human health and livelihoods. Due to anticipated major climate change related concerns, it is projected that it will increase variability of monsoon rains to enhance the frequency and severity of high floods as during 2010 and recent past droughts. Incorporating realistic scenarios of water resources availability is a fundamental element of sustainable development. Water resources and climate change not only affects agriculture, but these also affect urban centers, industry and human health.

Management of water resources requires a balanced and careful review of current knowledge under a comprehensive framework for the national development purposes of all sectors of life including environmental requirements.

CONCLUSIONS

The shortfall of about 30 MAF of water by the year 2030 is to be met through creating storage facilities and diverting 21.5 MAF to canals which at present is flowing to sea after allowing 8.6 MAF for environmental flows. This additional diversion of 21.5 MAF at canal head would add about 15.6 MAF at farm gate. The program of water course improvement by 2030 will cover all the water courses of country enhancing water course efficiency significantly and will save wastage of water in the irrigation system. It may be emphasized that water plays a pivotal role in development of all sectors of life. In fact it is very true that water is really a naturally a source development of economies in the world.

RECOMMENDATIONS

Campaign on efficient use of water in domestic, industrial and agricultural sectors have been launched to disseminate knowledge and information to the water users especially farmers. Rain water harvesting and use of treated water are also being adopted. Water is key factor for agro-socio-economic uplift in the country. The additional storage and other relevant developments of efficient water use in the country would not only be able to sustain food security but also would export more agricultural products to sustain the economy.

4. WATER SAVING POTENTIAL IN RICE CROP USING BED PLANTATION TECHNIQUE

Author: Zamir Ahmed Soomro, Zia-ul-Haq and Khurram Ejaz

Abstract

Rice is one of the major staple food crops in Pakistan. About 13 percent of cropped area of the country is used for rice production. Average yield of rice in Pakistan is 2.95 t/ha, while USA and China are receiving 7.40 and 6.19 t/ha respectively. On average, the world's rice fields use about 1.4 m^3 of water for producing 1 kg rice with a water use efficiency (WUE) of 0.71 kg/m^3, whereas in Pakistan it is less than 0.45 kg/m^3. The major reason for low WUE is a mindset to grow rice in stagnant water. Pakistan Council of Research in Water Resources (PCRWR) conducted series of experiments for growing rice crop using bed plantation technique at its R&D Centre near Sargodha (Punjab). Comparing the conventional sowing (flooded basins), 23 percent less amount of water applied under the bed plantation. WUE and average net income increased by 37 and 12 percent respectively in bed plantation technique as compared to conventional sowing. In Pakistan rice is grown on about 2.8 Mha area consuming about 40 billion cubic meters (BCM) water by conventional sowing. If the conventional sowing is converted to bed plantation, about 9 BCM of water can be saved with additional net income of 39 Billion Rupees. The study concluded and recommended the significant water saving potential in bed plantation of rice crop.

CONCLUSIONS

Like any other crop, rice has it specific water requirement and does not essentially needs submerged conditions. Rice can be successfully grown on beds without compromising the yield with over 23% of water saving. In Pakistan rice is grown on about 2.8 Mha area consuming about 40 billion cubic meters (BCM) water by conventional sowing. If the conventional sowing is converted to bed plantation, about 9 BCM of water can be saved with additional net income of 39 Billion Rupees. Therefore, bed plantation is an inevitable option in water scared countries like Pakistan.

5. SENSITIVITY ANALYSIS OF ALLIEVI CHART PARAMETERS FOR WATER HAMMER- A CASE STUDY

Author: Engr. Muhammad Mohsin Munir, Engr. Kamran Ahmad

Abstract

In order to avoid large increase of pressure due to instantaneous valve closure for hydro-electric power plants, sometimes a surge tank is installed to overcome excessive water hammer. The height of surge tank is designed by the highest possible water level during the operation. The present study attempts to find sensitivity of various depending parameters (closure time 't', pipe diameter 'D', roughness 'n', temperature of water 't' etc.) using a worksheet model of Allievi chart; a numerical method for estimating the surge oscillation in a simple surge tank in terms of non-dimensional parameters (pipe line constant 'K' and time constant 'N'). The operation regimes were chosen for critical scenarios such as sudden load rejections of the turbines.

In the present study hydraulic design of penstock for Naltar Hydropower Project, a potential site in Pakistan, was analyzed for computing maximum and minimum pressure in penstock. Sensitivity curves for penstock pressure were plotted for case study project by variation of parameters such as pipe diameter, roughness, closure time etc. The results enable designers/engineers to understand phenomena of surge in pressure shafts/ penstocks under sudden closure for maintaining safe conditions without endangering the machines or the structures.

Conclusions and Recommendations

Based on this study, parameters have been arranged in increasing order of their sensitivity to pressure rise:

Temp < *Length* < *Pipe dia/Wave speed* < *Closure Time*

It is further observed from case study project that, pressure rise at closure time less than 3 sec increases exponentially

The study will be useful to assess sensitivity of these parameters while fixation of penstock pipe parameters and design of surge tank

6. NUTRIENT REMOVAL EFFICIENCY OF CONSTRUCTED WETLAND FOR WASTEWATER TREATMENT AND REUSE

Author: Kanza Naseer, Imran Hashmi

Abstract

With declining trend in global water resources, wastewater reclamation and reuse have gained considerable importance. Beside conventional wastewater treatment technologies, Biological treatment system such as constructed wetland is one of established wastewater treatment technology used for suspended solid removal, BOD reduction, nutrient management and pathogen reduction. Current study was conducted at NUST H-12 campus Islamabad to monitor organic removal efficiency from constructed wetland, consisting of eight ponds. Each pond has specific hydrophytes such as (Typha latifola, Pistia stratiotes, Centella asiatica). Grab Samples were collected from sedimentation tank (inflow), ponds and collection tank (outflow) and further processed to measure organic removal efficiency. Physicochemical and microbial parameters were analysed according to standard methods (APHA) to determine organics removal rate through wetland system, that includes pH, Temperature, Turbidity, Electrical Conductivity (EC), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Kjeldahl Nitrogen (TKN), Nitrate, Nitrite, Phosphate, Total coliforms and Helminthes quantification was also carried out by using Ballinger method. Significant spatial and temporal variations were observed with higher organics removal efficiency and final effluent proved to comply with the agriculture reuse standards. An excellent treatment efficiency was exhibited by the water quality parameters up to 74.2% for TSS, 74.2% COD, 95% Turbidity, 79% BOD, 68% Nitrite, 71% Nitrate, 69% TKN, 47.2% Phosphate, 83% Total Coliform and 99% Helminth eggs. Constructed wetland is proved to be efficient and reliable technique for removal of pollutants from domestic wastewater.

Conclusions and Recommendations

Constructed wetlands are efficient and cost-effective wastewater treatment Technology. It will enhance sustainable use of water in agriculture and irrigation sector. Treated wastewater improve the yield of unproductive soils. There is dire need for implementation of constructed wetlands as wastewater treatment systems in Pakistan by improving policies, financial management and institutional dialogues, which would ultimately improve the agricultural production and can, boost up the economy of the nation. Involvement of Public and other stakeholders should be ensured for implementation at larger scale.

This research will be helpful to create awareness among the masses in the form of research papers, newspaper clippings, seminars, and short training programs, poster presentations at local and international levels. This technique if implemented will reduce water borne diseases as mixing of wastewater with the drinking water supplies will be highly reduced which is the major aspect highlighted in Sustainable development goals.

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

Author: Yusra Maqbool, Nimra Fayyaz, Abdullah Yasar, Amtul Bari Tabinda and Naveed Anwar

Abstract:

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

Conclusion:

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

8. Need of Proper National-Action-Plan Under Appropriate Legislation / Regulations / Technologies/ Funding to Achieve Pakistan's Sustainable Development Goals[1] Specifically Goal 6 And Its Target 6.3[2]

Author: Engr. Abdul Qayyum

Abstract

The Human Right to Water and Sanitation was recognized by the United Nations (UN) General Assembly in 2010[3]. It has been recognized in international law through human rights treaties, declarations and other standards. It is derived from the human right to an adequate standard of living. Pakistan also has constitutionally promised to follow/ implement UN MDGs / SDGs. There are 17-UN SDGs, each has targets and indicators. Target 6.3[4] is regarding water and sanitation[5]. Astonishingly target 6.3 (although acknowledged human right) is not included in National SDGs[6].

In Pakistan due to nonconformity of MDGs (2000-2015)/ SDGs (2015-2030), high population growth, unplanned increasing urbanization, inefficient irrigation practices, lack of appropriate technologies, indefensible water uses and their fragmented management, especially unacceptable water supply/ sanitation system and absence of proper evaluation of floods/ floodplains/ regulations, the surface/ underground water has almost contaminated (Fig 1). These facts, triggered with climate change impacts, are more and more depleting and contaminating Pakistan's both water sources, i.e. surface as well as underground water, and the water almost is injurious both to human and aquatic life. Only passing of Climate Act-2017[7], issuing of National Climate change Policy[8] and/ or mere owning Sustainable Deployment Goals[9] is not sufficient.

Pakistan's Policy makers should clearly understand that economic prosperity, sustainable development and environmental stewardship present an intertwined challenge that must be addressed with coordinated and consistent policies both in and across departments, ministers and nations. Pakistan's owned/ adopted UN Sustainable Development Goals (2015-2030), which, if after revisiting, are implemented; provide a clear/ achievable path way to economic prosperity, sustainable development and environmental stewardship.

Keeping in view the extreme vulnerable, to economic prosperity, sustainable development and environmental stewardship, condition of Pakistan, the author, via PEC, through this paper requests the policy makers of Pakistan, to fulfill their

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1 http://www.un.org.pk/pakistans-challenges-sustainable-development-goals-2015-2030/

2 http://indicators.report/targets/

3 http://www.onwa.ca/upload/documents/un-water-as-a-human-right.pdf

4 http://indicators.report/targets/

5 http://www.sdg6monitoring.org/indicators/target-63/

6 https://www.pc.gov.pk/uploads/report/National_SDGs_Framework_-_NEC_2018.pdf

7 http://www.mocc.gov.pk/frmDetails.aspx

8 http://www.gcisc.org.pk/National_Climate_Change_Policy_2012.pdf

9 https://www.pc.gov.pk/uploads/report/National_SDGs_Framework_-_NEC_2018.pdf

commitment to UN/ Pakistani nation, to implement all the 17 SDG", so that the requisite prosperity, sustainable development and environmental stewardship is achieved to Pakistan. The paper will give special emphasis to target 6.3[1].

Conclusion

Our national SDGs frame work requires revisit. UN Agenda 2030[2] for Sustainable Development provides a global blueprint for dignity, peace and prosperity for people and the planet, now and in the future. The nations spent a few years into the Agenda, are experiencing a pleasant change in civil society, private sector, and governments are translating this shared vision into national development plans and strategies. Total goals are 17, each has its targets/ indicators to implement/ monitor the progress. Every Goal/ target/ indicator matters. Goal 6 is to ensure access to safe water sources and sanitation for all (worldwide, including Pakistan, acknowledged basic human right). The cost, if we do not correct the problem, is high both for the people and for the economy. Pakistan needs an action plan on priority bases so that the anticipated, rather calculated, benefits (section 2 c- above) are reached to the nation at the earliest.

Recommendations

United Nation's 17 Sustainable Development Goals[3] are a call for action by all countries – poor, rich and middle-income – to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection. Pakistan's policy makers (Federation including Federation-Units, technical/ legal experts, law and peace enforcing agencies) may be circulated the UN Agenda-2030 and the corresponding National Sustainable Development Goals framework[4], and then comprehensive discussions regarding:

i. Relative Priority of SDGs for Pakistan and then adequate selection of targets/indicators.

ii. Discussion on each goal/ targets/ indicators (of both SDGs) and inclusion in National SDGs, if some target/ indicator is missing in National SDGs.

iii. Threats, to Pakistan, mentioned in sections-6 are of more significant than terrorism, faced by Pakistan during the last few decades, therefore, let us consider the constitution of a National- Action- Plan (2019-2030) to combat the threats of section 6, including the promotion of prosperity, eradication of poverty, addressing a range of social needs including education, health, social protection and job opportunities, while tracking climate change and environmental protection, through the implementation of integrated program of implementing SDGs, in Pakistan.

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1 http://www.sdg6monitoring.org/indicators/target-63/

2 https://www.un.org/sustainabledevelopment/sustainable-development-goals/

3 https://www.un.org/sustainabledevelopment/

4 https://www.pc.gov.pk/uploads/report/National_SDGs_Framework_-_NEC_2018.pdf

9. WATER QUALITY ASSESSMENT OF RAWAL DAM WITH SPECIAL CONSIDERATION TO CHATTAR, MURREE STREAM

Author: Hamza Bin Riaz, Imran Hashmi

Abstract:

Rawal Dam being the only water reservoir of Rawalpindi and Islamabad, serves the water needs of millions of people for their domestic and drinking usage. There is a serious need for appropriate water quality monitoring for future planning and management of water resource. Rawal Dam depends on number of streams and river for its replenishing, one being the Chattar Stream, located near the Murree hill station, it falls into the Korang river, which flows directly into the Rawal Dam, thus making a huge portion of the water reserved in it, thus water quality assessment of the Chattar-stream is necessary. The water quality parameters of the stream were assessed, for which nine grab samples were collected from each of its two sub divisions; the small and the large one. The physico-chemical parameters were assessed using standard protocols, these include pH, Temperature, Turbidity, Electrical Conductivity (EC), Total Dissolved Solid (TDS), Dissolved Oxygen (DO), Hardness, Alkalinity, Chemical Oxygen Demand (COD), Nitrate, Nitrite, Total Kjeldahl Nitrogen (TKN) and Phosphate, whereas microbiological parameter assessed was *Escherichia coli* by (MPN) most probable number technique. The study reveals that all the parameters were within the WHO permissible limits. The presence of organic matter, waste water intrusion was also obvious as reflected by COD, Nitrate, Nitrite and Total Kjeldahl Nitrogen. Presence of *Escherichia coli* in almost all the samples implies the deteriorating quality of water in the stream.

Conclusion and Recommendations

Study reveals that all the parameters were within the WHO permissible limits. Presence of organic matter, waste water intrusion was also obvious as reflected by COD, Nitrate, Nitrite and Total Kjeldahl Nitrogen. Also, there is a presence of *Escherichia coli* in almost all the samples implies the deteriorating quality of water in the stream

- Above studies have provided baseline infrastructure for research efforts and create awareness regarding Water Quality Assessment.
- Based on results, recommendations were proposed to government, EPAs, Ministry of Climate Change, RDA, CDA and WASA.
- Drafting guidelines and regular monitoring for water disinfection and for existing water testing laboratories to ensure safe water to the consumers.
- Consequently, strengthening existing water quality scenario to some extent prevailing in the country and thereby reducing overall budget disbursed on health infrastructure.
- In addition, best management practices and training was imparted for the provision of adequate water and sanitation services in Pakistan.

10 WATER CONTAMINATION AS A MAIN SOURCE OF WATER SCARCITY IN PAKISTAN

Author: M. Iftikhar, B. K. Bakht, Dr. Eng. A. Yasar, Dr. A.B Tabinda, M. N. Anwar

Abstract:

In Pakistan the ground water is one of the major sources of water consumption and it is also a valuable resource, but due to landfill leachate, uncontrolled hazardous waste sites, freeway disposal of wastewater from industries and agriculture causes the pollution of natural water resource. The research shows that Arsenic and Fluorine are two major pollutants in groundwater of Pakistan and more than 50% of groundwater wells have their increase concentrations even it exceeds from the permissible WHO limits results in water shortage and various health related problems like anemia, gastrointestinal irritation, lung infections, hepatitis, intestinal infections and diarrhea, dysentery, cholera, respiratory paralysis, typhoid fever, jaundice and skin diseases in children as well as in older and younger adults. This review sums up the outcomes of various research studies conducted for groundwater quality status and water shortage in Pakistan. The scarcity of safe and healthy water sources causes 20% of the population to use clean water, but the rest of 80% population has no access to safe water. The study shows that there is an immediate need of taking measures to control groundwater contamination and water scarcity such as management of waste, use water wisely, reduce, reuse, recycle, use fewer chemicals, plant more trees and spread awareness about water contamination and water scarcity.

CONCLUSION AND RECOMMENDATIONS

In Pakistan the drinking water is not safe for human consumption because the pollutant contents are in increase concentration even they exceed from permissible quality standards. The heavy metals concentration is also increasing from standards and limits set by WHO (World Health Organization). The most common heavy metals are Chromium, Iron, Cadmium, Nickel and Arsenic. Fluoride and Nitrates are also a threat in some parts as fluoride in some areas is very low whereas in some parts it is very high. The main source of water pollution is uncontrolled municipal waste and untreated industrial wastes. In rural areas the monitoring of water quality is totally absent (Aziz; 2005). The water disinfection practices like chlorination is either unsatisfactory or nonexistent. This causes serious human related problems.

Waterborne disease is the main issue cause by the chemical and bacteriological pollution of public drinking water. The is an insufficient record of water related diseases and the lack of diagnostic technology contributed to the blur picture of water linked diseases result in poor handling of these diseases.

There are various recommendations to the problem of deteriorating water quality:

1. The proper monitory procedures should be introduced in every part of the country.
2. Purification of water should be made mandatory by local authorities.

3. The continuous water supply should be compulsory in order to avoid intermittent contamination and to fulfill the water needs.
4. The sewage pipelines should be away from water supply.
5. It should made compulsory for industries to install waste water treatment plants. The industrial water should be monitor regularly.
6. The pesticides should be treated safely. The farmers should provide regular education and awareness about the use and disposal of pesticides.
7. There should be guidance for storage of water inside the houses.
8. There is a strong need of implementation of strict laws.
9. The old rusty water supply lines should be treated regularly.
10. There is a need for proper sewage handling in urban areas of Pakistan. (Azizullah ;2011)

CLIMATE CHANGE, SCARCITY OF WATER/ENERGY IN PAKISTAN AND SOLUTIONS THROUGH EDUCATION, CLEAN ENERGY, FLOOD PLAINS / SEWERAGE REGULATIONS / MANAGEMENT

By

Engr. Abdul Qayyum[1]

1. Abstract:

The continuously growing water stressing / scarcity[2], due to global warming impacts, are already observed/experienced, throughout the world, leading to a situation in which available, inter alia, water resources are depleting and/or deteriorating, unable to satisfy the basic needs. Pakistan, especially, being far away from requisite measures/awareness, e.g. special requisite emphasis/focus on clean water/renewable energy[3], has entered in the group of countries that are now moving from the state of water stressing to water scarcity, involving toxins of extremely injurious, both to human and wild/aquatic life. High population growth, increasing urbanization without any regard of the impacts of climate change (e.g. ignoring the need/importance of rainwater-harvesting[4]/floodplains to recharge/ replenishing aquifers), inefficient irrigation practices, indefensible water uses and their fragmented management, especially unacceptable sewerage system and absence of proper evaluation of floods / floodplains against the adverse effects of anticipated climate change[5] and the requisite regulations / their implementations, in the light of flood Management rules, are placing enormous pressure on surface / ground water resources and recreation facilities all over Pakistan. Untreated waste water, both domestic and industry, when enters in adjacent nullahs, streams, canals and/or rivers, heavily pollutes all type of recipients. The dual problems of clean water shortage and untreated waste water overflow triggered with anticipated effects of climate change are serious, present and future, threats to Pakistan and needs serious attention for its solution on top priority / urgently in a strategic / synchronized manner. Presently almost all surface / ground water in Pakistan are polluted with E. coli and Arsenic, causing different deceases. More over the quantity of dissolved oxygen (DO) in river waters, especially when passing through towns / cities, has reduced to a prohibitive limit. Being the member of the United Nation's Framework Convention on Climate Change (UNFCCC) and after passing the climate change Act-2017, Pakistan, as responsible member to save the planet, should use its indigenous resources, which exist in abundance, of renewable energy with

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[1] Team Leader, Contracts/ Procurement/Structural Specialist Techno-Consult International (Pvt.) Ltd

[2] https://pubs.acs.org/doi/abs/10.1021/bk-2015-1206.ch010

[3] https://bigpicture.unfccc.int/

[4] https://www.slideshare.net/IEIGSC/techniques-of-rain-water-harvesting-in-urban-and-rural-areas

[5] https://www.businessdailyafrica.com/analysis/columnists/Climate-change-the-missing-link-in-Vision-2030/4259356-3895890-3imq30z/index.html

measurable progress and clear targets/deadlines. This in turn will help in achieving the priority thematic areas/goals of climate change, while making Pakistan one of the economical leaders in the world and ensure the prosperity of the people in environmentally sustainable conditions.

Hope the conclusions / recommendations, submitted via this paper through PEC, will form a basis of policy dictating /consideration/ implementation for Government of Pakistan.

2. INTRODUCTION:

a. Literature Survey

More than 50 years ago, impacts, higher average temperatures, increased, prolonged drought periods, may be four to five years, and then excessive rainfall and / or rising seawater levels, of climate change were first diagnosed by the scientists and they started warning the world. Now the scientists have established that the extreme weathers are linked to climate change. This aspect is being observed/experienced throughout the world. The world, especially the developed countries, through United Nation, recognized the severity and, inter alia, following activities[1] were adapted through education:

i. Climate change in the news
ii. Living with climate change
iii. Climate change science
iv. The Earth's energy budget
v. Dynamic modeling
vi. Dynamic modeling 2
vii. A simple climate model
viii. Climate prediction net results so far
ix. Greenhouse gas emissions forecasts
x. Clues from the past
xi. Why is carbon dioxide so important?
xii. Feedback and forcing
xiii. Case study: Why is the arctic warming so fast?
xiv. Climate change impacts
xv. Problem based learning
xvi. The climate change challenge
xvii. Political responses to climate change
xviii. A debate on the issues
xix. Exam-style question: Emission scenarios

[1] http://www.nuffieldfoundation.org/science-society/activities-responding-global-climate-change

xx. International decision making Year by year, as the United Nations Framework Convention on Climate Change 1992 (UNFCCC 1992) moves from one Conference of the Parties (COP) to the next , until Paris Agreement and the upcoming Katowice (Poland) Climate Change Conference (UNFCCC-COP-24) scheduled on 3-14 Dec. 2018.

As a result of above mentioned efforts, climate change Greenhouse Gas emissions have been started to decline[1] in over the two dozen of the largest cities (from Berlin to New York) of the world.

b. According to GCRI-2018[2]- Key Results of Global Climate are:

People all over the world have to face the reality of climate variability – in many parts of the world this has demonstrated in the increased volatility of extreme weather events (exceptional floods, droughts, heat waves, rising of sea level, sinking of adjacent coastal areas etc.). Between 1997 and 2016, more than 524 000 people died worldwide and losses of US$ 3.16 trillion in Purchasing Power Parities (PPP) were incurred as a direct result of more than 11 000 extreme weather events. The UNEP's (United Nations Environment Program) Adaptation Gap Report 2016 warns of the increasing impacts and resulting increases in global adaptation costs by 2030 or 2050 that will likely be much higher than currently expected: "two-to-three times higher than current global estimates by 2030, and potentially four-to-five times higher by 2050". These numbers do not include costs resulting from residual risks or unavoidable losses and damage. This indicates that the gap between the necessary financing to deal with climate-induced risks and impacts is even larger. On the other hand, the report highlights the importance of enhanced mitigation action towards limiting the global temperature increase to below 2°C, which could then help to avoid substantive costs and hardships.

c. Disaster & Climate Resilience

The author, as team leader, has recently completed a Disaster & Climate Resilience Improvement Project named as, "FEASIBILITY STUDY & DESIGN FOR FLOOD PROTECTION OF KOTLI MANDI CITY AND OTHER VULNERABLE AREAS BOTH SIDES OF RIVER POONCH" in AJK Pakistan and the conclusions, recommendations, derived from the study, are urgently needed to be adapted / expanded throughout Pakistan, so that a balance is achieved between the integrated planning / scheduling / designing and implementation vs. vulnerability due to impacts of climate change. Following, impliedly, are the Conclusions / Recommendations:

i. FIRR/ EIRR/ BCR

The Projects, under different scenarios of the expected impacts of climate change, in an integrated/synchronized/systematic manner, should be analyzed economically/financially as **"risk mitigation projects[3]"**. This will ensure acceptable values of FIRR/EIRR/BCR and consequently arrangement

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1 https://www.dw.com/en/climate-change-greenhouse-gas-emissions-decline-in-cities-from-berlin-to-new-york/a-45482304

2 https://germanwatch.org/en/cri

3 http://siteresources.worldbank.org/PROJECTS/Resources/40940-1365611011935/Guidance_Note_Economic_Analysis.pdf

of funds, from any reasonable funding agency, shall be easily managed. Further as, Pakistan contributes very little to the overall (globally) Greenhouse Gas (GHG) emissions, but is extremely vulnerable to the impacts of climate change therefore UNEP and UNFCCC, under its climate change Finance Fund, also can assist, from their funds allocated for climate change, provided the case is prepared in a systematic rational / professional / competent way. All nullahs / streams / rivers, including the three (3) western rivers (figure 01) of Pakistan, should be included in this exercise.

ii. Floodplain Regulations[1]

To cater the possible adverse effects of climate changes, (may be 4 to 5 years drought and then the accumulative rains of very high intensity in one year, during the coming years- title page) adequate legislation regarding Floodplain **(based on appropriate return period of floods)** regulations and then its implementation, followed by Flood Management is needed / recommended, in an integrated / synchronized manner. All nullahs/streams/rivers, including the three (3) western rivers should be included in this exercise (figure 1). Inter alia, this will help recharging of aquifers with clean water in Pakistan.

iii. Biological Contamination in Underground Water/aquifers/ Drinking Water[2] and Its Effects[3]

As per requirements of the standards, mentioned in framework / directives / regulations of EPA Pakistan, E. coli or thermo tolerant Coliform Bacteria must not be detected in all water intended for drinking, but the microbiological analysis of the samples in the project area, including almost whole Kotli, confirmed that nearly every sample, except army area, has some biological contamination (pathogen). Experience while working with WASA Lahore, also confirmed that depleting and contaminating of ground water / aquifers is taking place at large.

iv. Dissolved Oxygen (DO) in Rivers/Streams

As dissolved oxygen levels in water drop (in rivers and streams) below 5.0 mg/l[4], aquatic life (shallow water life, such as fishes etc.) is put under stress, the lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. During study, it was known that the DO level, present in river water was prohibitively (figure 2) low.

To improve this situation, it is recommended that a proper legislation and then adequate regulations on BOD / COD maximum values of waste-water, domestic/industrial, to be allowed to enter in all types of recipients (nullahs, streams and rivers including 3 western river etc.) be made, so that only the adequately treated waste water (having BOD and / or COD values less than

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1 https://www.fema.gov/floodplain-management-ordinances

2 https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations

3 https://www.epa.gov/privatewells/potential-well-water-contaminants-and-their-impacts

4 https://www.lenntech.com/why_the_oxygen_dissolved_is_important.htm

or equal to those specified in BOD / COD regulations) should be allowed to enter in the all types of recipients.

d. Integrated Flood Management

Integrated Flood Management (IFM) is a concept that addresses issues of human security against flood risks and sustainable development within the framework of Integrated Water Resources Management (IWRM). This requirement gets special priority when Pakistan, consequent upon climate change impacts, is expected to face exceptional high floods due to Glacier melt in the Himalayas in future. Special attention is required for all rivers included the 3 western rivers. Such an integrated approach to flood management can play an important role in sustainable development and poverty reduction. Integrated Flood Management aims at minimizing loss of life from flooding while maximizing the net benefits derived from flood plains. As part of the approach, the reduction of flood risks is based on a judicious combination of measures dealing with the magnitude of the flood hazard/capacity of stream and the vulnerability of the adjacent areas / community's exposure. Adequate balance with safety factor is needed to the resilience and vulnerability.

e. Impacts on Pakistan

Pakistan contributes very little to the overall Greenhouse Gas (GHG) emissions, but is severely prone to negative impacts[1] of climate change by the following ways:

i. Glacier melt in the Himalayas, due to expected rise in temperature, is projected to increase flooding, which in turn will affect already under stressed water resources. This will be followed by decreased river flows over time as glaciers recede.

ii. Freshwater availability is also projected to decrease further which will lead to biodiversity loss and reduce availability of freshwater for the population.

iii. Coastal areas bordering the Arabian Sea in the south of Pakistan will be at greatest risk due to increased flooding from the sea and in some cases, the rivers.

iv. Being a predominantly agriculture economy, climate change is estimated to decrease crop yields in Pakistan which in turn will affect livelihoods and food production. Combining the decreased yields with the current rapid population growth and poor urbanization in the country, the risk of hunger and food security will raise high.

v. Widespread morbidity and mortality due to diseases primarily associated with floods and droughts are expected to rise. Increases in coastal water temperatures would intensify the abundance of cholera.

vi. The impact of climate change will also aggravate the existing social inequalities of resource use and intensify social factors leading to instability, conflicts, displacement of people and changes in migration patterns.

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[1] http://www.lead.org.pk/cc/basicguide_climate_change.html

vii. Unattended floodplains of all rivers in Pakistan, especially the three western rivers can cause huge disasters.

viii. According to Global Climate Risk Index (CRI-2018) , Pakistan ranks at 7th position (period 1997-2016) among the most adversely affected countries by Climate Change. Inter alia, only financial loss, leaving the residual losses, was of the tune of US$ 3816.82 Million.

f. Rainwater Harvesting

To overcome the adverse effects of climate change / deficiency in recharging of aquifers/pollution of aquifers, to a reasonable extent, we may need, inter alia, shifting away from surface water sources to groundwater seriously, when developing strategies for drinking water provisions. Rainwater Harvesting is an important tool and proven method of recharging of aquifers. Rainwater Harvesting in a sustainable manner, both in urban and rural areas, is also proposed to take in background of strategic approach, for directing policies, inter alia, to meet water stress / scarcity / recharging of aquifers in Pakistan.

g. Pakistan's National Climate Change Policy/Climate Change Act;

Although too late, but Pakistan has launched its Climate Change Policy and Pakistan's National Assembly, to meet Pakistan's obligations under interactional conventions relating to climate change and address the effects of climate change and for matters connected therewith and ancillary thereto, has passed the Pakistan Climate Change Act, 2017 on April 28-2017.

Unfortunately practically nothing out of the activities mentioned in Para 'a' above and/or promised in Climate Change Act, 2017' regarding the UNFCCC's priority thematic actions/activities , is done therefore it can be inferred that: now the time for Pakistan is running out rapidly. Indeed, as per UNEP non-actions on ground, have created huge gap between requirements and actions and thereby with each decade of delay and denial, regarding impacts and measures, the impacts and costs of requisite measures against climate change have continued to mount up.

This paper, to achieve thematic areas/goals indicated by UNFCCC, in light of existing scenario of Vulnerability and/or requisite Resilience of infrastructures against impacts of Climate Change in Pakistan, based on reliable / tested international documentation[1] on Climate Change / Finance[2]/Pakistan Climate Change Act[3] and as laid in 'UNFCCC Rule Book', will dwell in detail on various aspects of climate change in Pakistan and propose adaptations, specifically indigenous efficient renewable energy against the Vulnerability of existing / future infrastructures[4], inter alia, through appropriate valuation of floods / floodplains / water-supply / sewerage / rainwater-harvesting and then emphasis on legislation / regulations for implementation through adequate management. Special focus shall be on the formulation of strategy regarding production and management of indigenous/efficient renewable energy including other relevant thematic goals. The

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1 https://unfccc.int/process-and-meetings/the-convention/glossary-of-climate-change-acronyms-and-terms

2 http://www.np.undp.org/content/dam/nepal/docs/reports/2017_reports/CF_Glossary_Final_July2017.pdf

3 http://nasirlawsite.com/laws/pcca2017.htm

4 http://www.who.int/water_sanitation_health/publications/9789241598422/en/

conclusions/recommendations, submitted through this paper, will form a basis of policy dictating/implementation for Government considerations in Pakistan.

3. Worldwide Actions Vs. Pakistan:

The 1992 United Nations Framework Convention on Climate Change (referred to as the UNFCCC), including the subsequent activities, provide the foundation for multilateral actions to combat climate change and its impacts on humanity and ecosystems. The 1997 Kyoto Protocol and the 2015 Paris Agreement were negotiated and built under the UNFCCC. The objective of the UNFCCC is to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

In pursuit of this objective, almost all the world is moving forward with climate actions. China has reached its 2020 solar power target three years ahead of schedule[1], after installed capacity topped well over its 105 GW target. Europe has been urged to show similar ambition. In 2016 renewable energy represented 17 % of energy consumed in the EU, on a path to the 2020 target of 20 %[2]. Further the EU has undertaken[3] to reduce its greenhouse gas emissions by 80 to 95 per cent compared with 1990 by 2050. India is one of the countries with the largest production of energy from renewable[4] sources. In the electricity sector, renewable energy (excluding large hydro) accounted for 20% of the total installed power capacity as of 30 June 2018. Large hydro installed capacity was 45.29 GW as of 31 March 2018, contributing to 13% of the total power capacity. Thus, renewable energy including large scale hydro-power currently adds up to more than 33% of the total installed power capacity in India. India has a separate measureable with clear targets/deadlines vision of pumped storage hydro and established an independent ministry for renewable energy. Meanwhile, increasing the renewable energy share to 27% would save the US economy between USD 30 and USD 140 billion per year by 2030 when accounting for benefits resulting from reduced health effects and CO_2 emissions. Germany looks set for a bright future with solar energy. Their renewable energy output including solar has increased more than eightfold since 1990. In 2015, they set a record for meeting up to 80% of the country's electricity demand with renewables by 2050[5].

Contrary, inter alia, Pakistan[6] is facing the worst power and water crises; the average shortfall of electricity is above 6000 MW while 25% of Pakistani population is still not connected to national grids and living in stone ages without modern blessings of electricity. Similarly Water shortage has also emerged as one of the most complex challenges faced to Pakistan and a full-blown water crisis, both quality/quantity wise, is hovering on stability and security of the country. Floodplains of all rivers, including the 3 western rivers need special attention for evaluation of

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1 https://www.euractiv.com/section/energy/news/china-eclipses-europe-as-2020-solar-power-target-is-smashed/

2 https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

3 https://unfccc.int/files/focus/application/pdf/161114_climate_action_plan_2050.pdf

4 https://en.wikipedia.org/wiki/Renewable_energy_in_India

5 https://www.businesslive.co.za/bd/companies/energy/2017-07-18-germany-aims-for-80-of-its-energy-from-renewables-within-35-years

6 http://fouzintl.com

appropriate floods and then management. This requires proper legislation/regulations for designing/implementation throughout Pakistan. Once enjoying abundant availability of water to the tune of 5200 m^3 / capita / annum, the country now possesses alarmingly low quality/quantity water availability i.e. below 1000 m^3 / capita / annum. In an arena of a strong connection among water, food and energy security, decline on almost all these fronts is being felt severely and will exert detrimental impacts on other fronts as well.

As stated earlier, Pakistan has launched its Climate Change Policy and Pakistan's National Assembly, to meet Pakistan's obligations under interactional conventions relating to climate change and address the effects of climate change and for matters connected therewith and ancillary thereto, has passed the Pakistan Climate Change Act, 2017 on April 28-2017. Sole passing the act is not sufficient and indeed now the time is passing out rapidly. Pakistan needs to follow the UNFCCC 'rule book' in letter and spirit.

Nature has endowed Pakistan with a huge solar potential of 9.5 Million MW[1] and 320 plus sunny days in a year. If managed in an integrated/harmonized/synchronized manner the energy / water resources in Pakistan are of heartening picture.

Besides solar energy potential; Pakistan possesses above 46000 MW of wind energy capacities in its defined wind energy corridors of Jhampir, Badin and Gwadar belts. Similarly, Geo-thermal bio-mass, bio-fuels and other resources of alternative energy are also available in bulk in Pakistan. To integrate/synchronize all the indigenous resources of renewable energy and to make the national grid efficient, there are sufficient natural sites of of pumped storage energy in Pakistan.

To meet the climate challenges, renewable energy is ultimately to dominate[2] the market; therefore Pakistan needs (Annex 1) the ways to store the energy so that all renewable indigenous resources are integrated/optimized and then used round the clock. The good news is that it is easy to store energy. All you need is two small reservoirs – one high, one low – and a way to pump water between them, and this type of energy is called pumped storage energy, well established all over the world.

Indeed **Pumped-storage hydroelectricity** (**PSH**), or **pumped hydroelectric energy storage** (**PHES**), is a type of hydroelectric energy used by electric power systems for load balancing. Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal/other fossil-fuel or nuclear) to be saved for periods of higher demand. In other words, the pumped storage energy production provides the means of integrating/ harmonizing / synchronizing / exploiting / optimizing different sources (solar, wind, hydro, thermal etc.) in a cost effective/efficient way, with minimum possible outages.

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1 https://sbcp.com.pk/2018/08/05/latest-news-2/#

2 http://theconversation.com/how-pushing-water-uphill-can-solve-our-renewable-energy-issues-28196

Countries with the largest power pumped-storage hydro capacity in 2017[1]	
Country	Power capacity (GW)
China	32
Japan	28.3
United states	22.6
Spain	8
Italy	7.1
India	6.8
Switzerland	6.4
France	5.8

In June 2018 the Australian federal government announced that 14 sites had been identified in Tasmania for pumped storage hydro, with the potential of adding 4 8 GW to the national grid if a second interconnector beneath the Bass Straight was constructed.

Pakistan should also contribute (by exploiting/integrating/synchronizing all available energy resources: wind, solar, hydro, pumped storage, conventional hydro and thermal etc.) its part, with time line and targets, having due regard of 'rule-book COP 23 UNFCCC'[2] guidelines., say up to 2020, 2025, 2030 etc., as promised via climate Act 2017/required by UNFCCC, this in turn will enable Pakistan to deal its energy/water and economic crises in a scientific/ respectful manner.

4. Vulnerability, Adaptation and Resilience: According to UNFCCC Rule Book:

i. **Vulnerability**: the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed to its sensitivity, and its adaptive capacity.

ii. **Adaptation**, in the simplest terms, refers to the actions that countries will need to take to respond to the impacts of climate change that are already happening, while at the same time preparing for future impacts. It refers to changes in processes, practices and structures that can reduce our vulnerability to climate change impacts, such as sea level rise or food insecurity. It also includes making the most of

[1] https://en.wikipedia.org/wiki/Pumped-storage_hydroelectricity

[2] https://www.dw.com/en/cop23-writing-the-paris-accord-rule-book/a-41200149

any beneficial opportunities associated with climate change, such as increased crop yields or longer growing seasons in some regions.

Adaptation solutions take many shapes and forms, depending on the unique context of a community, business, organization, country or region. There is no 'one-size-fits-all-solution'—adaptation can range from building flood defenses, setting up early warning systems for cyclones and switching to drought-resistant crops, to redesigning communication systems, business operations and government policies. Many nations and communities are already taking steps to build resilient societies and economies, but far greater action and ambition will be needed to cost effectively manage the risks, both now and in the future.

iii. **Resilience:** the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

iv. **Climate Finance Fund:** In accordance with the principle of "common but differentiated responsibility and respective capabilities" set out in the Convention, developed country Parties are to provide financial resources to assist developing country Parties in implementing the objectives of the UNFCCC. The Paris Agreement reaffirms the obligations of developed countries, while for the first time also encouraging voluntary contributions by other Parties. Developed country Parties should also continue to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies, and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts.

Overall, efforts under the Paris Agreement are guided by its aim of making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. Assessing progress in provision and mobilization of support is also part of the global stock taken under the Agreement. The Paris Agreement also places emphasis on the transparency and enhanced predictability of financial support.

At the United Nations climate change conference in Paris, COP 21, governments agreed that mobilizing stronger and more ambitious climate action is urgently required to achieve the goals of the Paris Agreement. Action must come from governments, cities, regions, businesses and investors. Everyone has a role to play in effectively implementing the Paris Agreement.

Global warming isn't just an environmental problem — it will affect every aspect of human life. Our response has to be just a wide-reaching — and experts say people power can still save the planet.

5. Benefits of Clean Water / Energy, Resilient Water Supply / Sewerage, Costal Areas Management, and Rainwater Harvesting:

- Less global warming and thereby less climate effects
- Improved public health
- Inexhaustible energy
- Jobs and other economic benefits, especially for Pakistan it can be a battery for economic growth.
- Stable/reasonably affordable energy prices
- Reliability and resilience to the system
- Improvement in ecosystem of Pakistan
- Improvement in recharging of aquifers with clean water
- The coastal areas of Pakistan against vulnerability to climate change and climate-driven impacts shall gain appropriate resilience

Best managements regarding clean water/energy and resilient water supply / sewerage use and measures for resilient coastal areas are inter-related and also related the impacts of climate change. Most developing [1]countries including Pakistan have more than 500,000 deaths related to unclean drinking water each year, which include at least 2,200 children. To combat this widespread issue, researchers have developed or are developing new technologies and processes as long-term solutions.

One of the initial issues of water contamination is human pollution mainly due to inadequate water supply/sewerage in Pakistan and then the use of fossil fuels for energy production, despite the fact that Pakistan has indigenous resources of renewable energy in abundance. Updated/resilient to climate change water supply / sewerage system[2] is a prerequisite of healthy ecosystem of any country. Pakistan is far away from this requirement. Renewable energy technology has taken a front seat on the industrial and economic stage, mainly due to the need to preserve our planet's fresh water supply. Parties, including Pakistan, to the UNFCCC and the Paris Agreement recognize that adaptation is a global challenge faced by all local, subnational, national, regional and international dimensions.

Water / water supply / sanitation / sea rising/ energy issues are multi-dimensional including economic, social, political and cultural aspects. The United Nations Millennium Declaration adopted the goal of reducing by half the proportion of people without access to safe drinking water by the 2015. An additional goal was set at the

[1] https://globalwarmingisreal.com/2017/10/31/is-there-a-link-between-renewable-energy-and-clean-drinking-water/

[2] https://link.springer.com/book/10.1007/978-94-007-0280-6

World Summit on Sustainable Development in Johannesburg to reduce by half the proportion of people without access to basic sanitation by 2015[1]. Proper assessment of vulnerability and then requisite resilience through appropriate adaptation of all water supply/sanitation system/floodplains/coastal areas against anticipated impacts of climate changes is needed on urgent/priority basis. Unattended/unplanned, with illegal encroachments, floodplains, almost of all the rivers / nullahs (Fig. 1), are a serious threat to whole Pakistan under the anticipated floods due to climate change. Adequate legislation / regulations / implementation are required on urgent / necessary basis.

Pakistan ratified[2] as member of UNFCCC on June 01, 1994 and Pakistan's Parliament passed[3] climate change Act on March 24-2017, to fulfill its obligations, as member, laid in UNFCCC rule book.

6. Summary for Policy[4] Makers / Climate Actions Now:

According to UNFCCC, the Priority thematic areas are**:**

i. Renewable energy**.**
ii. Energy efficiency.
iii. Transport.
iv. Carbon capture, use and storage.
v. Non-CO^2 greenhouse gases.
vi. Land use climate action**.**
vii. Adaptation co-benefits.

Further Climate action now offers every nation on the planet a clear path towards the shared aim of a healthier, more prosperous and more secure future. Nations now increasingly understand that economic prosperity, sustainable development and environmental stewardship present an intertwined challenge that must be addressed with coordinated and consistent policies both in and across ministries and nations. **All Nations also understand that climate change presents the single biggest threat, to the hard won advances, the world has made, under the Millennium Development Goals and will be a defining factor in the success or failure of the 2015 Sustainable Development Goals, depending on whether or not we allow the global temperature rise this century to exceed 2 degrees Celsius.** Responding to climate change is a generational journey, an effort that must be sustained and increased over decades to come. The sooner and faster the world acts the greater chance of arriving at the future we all need.

7. Conclusion:

As Pakistan is a developing country, therefore renewable energy/efficiency thereof/ Water/ water-supply/sanitation/energy issues / floodplains and coastal area issues

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1 http://www.dsi.gov.tr/docs/iklimdegisikligi/post_2012_climate_change_negotiations_guidebook_turkey.pdf?sfvrsn=2

https://en.wikipedia.org/wiki/List_of_parties_to_the_United_Nations_Framework_Convention_on_Climate_Change#List_of_parties

3 https://tribune.com.pk/story/1364644/pakistan-passes-climate-change-act-reviving-hopes-scepticism/

4 https://unfccc.int/resource/climateaction2020/media/1173/21789-spm-unfccc-lowres.pdf

are covered under UNFCCC's rule book and come under the definition of "**Adaptation**" and as promised by Pakistan via climate act 2017, must be assessed and developed/prepared in a strategically systematic/efficient way which optimizes benefits thereof, while minimizing negative environmental impacts. In this way Pakistan can meet the present economic/water/energy/floodplains/coastal areas' issues while can get reasonable financing from **Climate Finance Fund** and manage the floodplains of all rivers, almost 40 smaller or larger (fig 1), and also fulfill its commitment regarding green Pakistan, promised via climate act 2017. The only stipulation is that the assignment should be performed under established good engineering practices using advanced technologies while maintaining requisite transparency[1] with measurable targets and clear deadlines for improving the lives of all Pakistani's especially the Pakistan's poorest people.

8. Recommendations:

As stated above, responding to climate change is a generational journey, the sooner and faster Pakistan acts the greater chance of Pakistani people of arriving at the future, they indeed need. Therefore to meet the target following recommendations are made;

i. **Education[2];**

Like other countries, the activities mentioned in paragraph (2. a), may be started in Pakistan through education and news, so that the general people/society gets requisite awareness/relevant-actions regarding climate change and its impacts.

ii. UNFCCC's the first two Priorities thematic areas are **Renewable Energy** and **Energy efficiency** while almost all countries, except Pakistan, have set with measureable progress and clear deadlines, their goals for the inclusion of renewable energy with means of efficiency in their national grid-systems. Indigenous means/resources (Solar, Wind, geothermal, pumped storage) of clean energy are available in Pakistan and as recommended, regarding pumped storage energy- a proven mean of making the system efficient, by the then General Manager Hydel WAPDA, in 2007, to all concerned, Annex 1, it is now recommended that :

Some very highly qualified and competent group(s) of consultants be engaged to carry out comprehensive studies in the overall perspective of available; Hydro (conventional + pumped storage), wind, solar and geothermal energy potential, system conditions and country's future demand with measureable progress of renewable energy/efficiency means and clear deadlines as how/when the total potential can be exploited, so that Pakistan is able to fulfill its obligations, as member of UNFCCC, promised in 1994 and again confirmed via Climate ACT 2017. This in turn will improve the economy of Pakistan, ensuring the prosperity of the people of Pakistan; rather it can become the battery of economic growth in Pakistan.

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1 http://www.mdgfund.org/node/922

2 http://www.nuffieldfoundation.org/science-society/activities-responding-global-climate-change

iii. Pakistan, like United Nations' Millennium Declaration, should adopt/formulize some mechanism[1] so that vulnerability of the existing water-supply/sewerage system is determined[2] and then adaptation to water supply and sanitation under the UNFCCC program, for existing and future requirements, is carried out in a measureable progress with clear deadlines. It will improve the ecosystem in Pakistan.

iv. One of the most adverse effects of the climate change is the occurrence of exception high floods, therefore it is recommended that:

Adequate valuation of floods, legislation regarding Floodplain Regulations and then its implementation on urgent basis in all over Floodplains (fig. 1), including the three(03) western n rives, of Pakistan is recommended on urgent basis. If formulated and enforced, then Flood Plains are to be used under proper Flood Regulations followed by flood management[3], and can provide best measures of recreation/ environment to local people and can cause guaranteed protection which can reduce poverty and improve quality of life thereby associated with reducing the vulnerability of the people. It, in a scientific/safe way, will fulfill Pakistan's promise, made through Climate Act-2017 to UNFCCC, of making green Pakistan.

v. Rainwater Harvesting[4]: While developing rural/urban areas, due provisions should be made for rainwater harvesting. It, inter alia, will help in charging the aquifers with clean water.

vi. The impacts of climate change, inter alia include sea level rise and sinking of the coastal areas (Karachi etc.), therefore proper/ investigations arrangements are recommended[5].

vii. In general the UNFCCC's remaining five thematic areas (Paragraph 6 above) are, perhaps indirectly, covered under the above recommendations and/or must be taken care of on urgent/ top priority basis, through a competent group of consultants

9. Important note[6]:

i. As actions/activities, required to fulfill the above recommendations come under the UNFCCC's definition of "**Adaptation**", therefore, if the above recommendations are worked out in a systematic/ competent/

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1 https://www.oecd.org/environment/outreach/Feasible%20adaptation%20strategy%20for%20WSS%20in%20Moldova_ENG%20web.pdf

2 http://ec.europa.eu/environment/marine/international-cooperation/pdf/Moldova_Task%201_Final_EN_26%20Feb.pdf.pdf

3 https://www.fema.gov/floodplain-management-definition

4 https://www.slideshare.net/IEIGSC/techniques-of-rain-water-harvesting-in-urban-and-rural-areas

5 https://www.epa.gov/arc-x/climate-adaptation-and-sea-level-rise

6 https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/pub_07_financial_flows.pdf

efficient/transparent way, **UNFCCC Finance Fund**, can easily be prayed[1]**.**

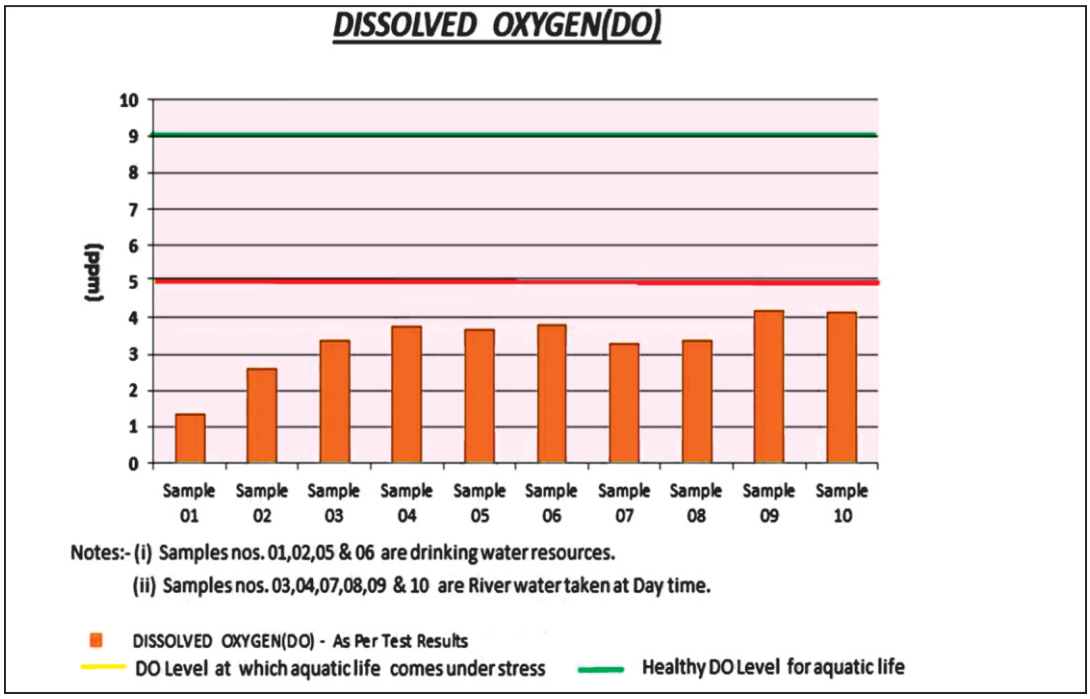
ii. Primarily the paper is prepared for Pakistan, but it, after incorporating the specific data of any other developing/poor country, is equally good for that specific country.

Figure 1



S.No	River	Sources of water	Details
1	Indus River	Sênggê Zangbo	At Tibetan Plateau The Tibetan Plateau lies between the Himalayan range to the south and the Taklamakan Desert to the north.
2	Jhelum River	Verinag Spring	At Pir Panjal Range is a group of mountains in the inner Himalayan region, running from east-southeast to west-northwest across the Indian
3	Sutlej River	Mount Kailash	Himalayas
4	Chenab River	Bara-lacha la	Himalayas
5	Ravi River	Chamba district	Chamba district of Himachal Pradesh, India
6	Kabul River	Sanglakh Range	Sanglakh Range is an offshoot of the Hindukush just west of Kabul
7	Gomal River	Katawaz Region	is a town in and administrative seat of Zarghun Shar District, Paktika Province, in eastern Afghanistan.
8	Neelum River	Vishansar Lake	Jammu and Kashmir, India.
9	Swat River	Hindu Kush Mountains	central Afghanistan to northern Pakistan
10	Zhob River	Pahzeen Valley(Tsari Mehtarzai)	Balochistan
11	Soan River	Bun Village	foothills of Patriata and Murree.
12	Gilgit River	Shandur lake	Gilgit-Baltistan
14	Kunar River	Hindu Kush Mountains	central Afghanistan to northern Pakistan
15	Hunza River	Kilik and Khunjerab nales(fed by glaciers)	Gilgit-Baltistan
16	Dasht River	Mirani Dam	south of the Central Makran Range in Kech District in Balochistan
17	Shyok River	Rimo Glacier	One of the tongues of Siachen Glacier
18	Hub River	Pab Range	south eastern Balochistan
19	Kurram River	20 km southeast of Gardez,	Afghanistan
20	Kunhar River	Lulusar Lake	Kaghan Valley.
21	Panjkora River	Hindu Kush Mountains	central Afghanistan to northern Pakistan
22	Gambila River	The source of the river lies in the hills six miles south of the Spin Ghar range	eastern Afghanistan
23	Ghaggar-Hakra River	Shivalik Hills, Himachal Pradesh	foothills of the Himalayas
24	Rupal River	Rupal Glacier	northern Pakistan
25	Lyari River	Drainage basin	North east of karachi
26	Tawi River	Kali Kundi glacier	Bhaderwah in Doda district of jammu and kashmir
27	Suru River	Panzella glacier	Kargil district of Jammu and Kashmi
28	Poonch River	south-facing foothills of Pir Panjal range	south of Jammu and Kashmir
29	Shigar River	Baltoro Glacier and Biafo Glacier	Gilgit-Baltistan
30	Neelum River	Vishansar Lake	Ganderbal, Kashmir valley
31	Dori River	sub tributary of the Helmand River	Kandahar Province in Afghanistan
32	Korang River	Murree Hills	Murree
33	Rakshan River	Nidoki pass, south-west of Shireza	District Washuk, Balochistan, Pakistan.
34	Braldu River	Baltoro Glacier Biafo Glacier	Gilgit-Baltistan
35	Haro River	Murree Hills	Murree
36	Bara river	Tirah Valley	Bara Tehsil, Khyber Agency.
37	Hispar River	Hispar Glacier	In the Karakoram mountains of Gilgit-Baltistan
38	River Jindi	hills of Malakand Agency	district of Charsadda, in Khyber-Pakhtunkhwa
39	Kundar River	Sulaiman Mountains	Balochistan

Figure 2



[1] http://www.mof.gov.np/uploads/document/file/CCFF_FINAL_Web_20180222050438.pdf

AJ&K AMBIENT AIR QUALITY – STATUS AND DEVELOPMENT STRATEGIES[1]

Dr Abdul Majeed[2]

Abstract

In AJ&K main sources of air pollution are human activities in particular vehicular emissions, wood combustion for energy, cooking and other domestic activities. The vehicles emit a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NOx), oxides of Sulphur (SOx) and Volatile Organic Compounds (VOCs). These emissions have an adverse impact on the air quality and health of human beings, particularly those who are directly exposed to this pollution. Fortunately in AJ&K the problem currently is not that severe because of low level of industrialization, good forest cover and watersheds, and lower volume of vehicular traffic as compared to most areas of Pakistan. However rapid developments in improving road network, energy and industrial expansion in AJ&K are causing problems of air pollution. Though legislative measures have been taken and standards are in place, the implementation of rules and regulations is a grey area that needs attention.

Measures such as conversion of vehicles to no lead gasoline and low sulfur diesel have been implemented but remain insufficient to prevent deterioration in ambient air quality in the urban areas due to increasing vehicle numbers and their hazardous emissions. Indoor air pollution is a major cause of widespread chronic bronchitis and other respiratory infections in rural households and poor urban households that depend on biomass for cooking and heating particularly in winters. To maintain air quality within acceptable limits, the study suggests various strategies grouped under the following development strategic objectives:

1. Improve Air Quality Monitoring and Forecasting System;
2. Establish functional data base of information on air quality with easy access by public
3. Raise general public awareness on clean air and environment to help promote the concept of clean production in industries and fuel efficient technologies in the industrial, transport and domestic sectors; and
4. Integrate environmental considerations in the Planning Process

1. Introduction

Ambient air refers to any unconfined portion of the atmosphere or outdoor air. It is a mixture of the gases such as Nitrogen (78%), Oxygen (21%), Carbon dioxide

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[1] The paper is extracted from a study funded by AJ&K Environmental Protection Agency (EPA) and was undertaken by International Union for Conservation of Nature (IUCN) Pakistan using DPSIR technique. The draft is yet to be approved by the Government of AJ&K.

[2] Water, Energy and Climate Change Adviser , IUCN Pakistan

(0.03%), and a small amount of Argon and other gases. Air Pollution occurs if there is a change in the composition of the ambient air caused by smoke, dust, gases, fumes, aerosols and odorous substances. Thus, in general terms, it may be defined as the presence of one or more contaminants like dust, mist, smoke and color in the atmosphere that are injurious to human beings, plants and animals.

It is a well-known fact that outdoor environment directly impacts human health. It is therefore important that the condition of the outdoor environment be improved to ensure better health status of people and decrease the number of illnesses. On the level of society it is important to adopt environmental management measures – managing the utilization of land, spatial planning of the environment used or to be used by humans, monitoring, assessment and management of risks, etc. The level of implementation of these measures and the allowance for the results in the adoption of decisions will determine the impact on each person's health.

According to WHO Ambient (outdoor) air pollution is a major cause of death and disease globally. The health effects range from increased hospital admissions and emergency room visits, to increased risk of premature death. An estimated 3 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children.

Studies have shown that poor air quality can also adversely affect the natural environment. Ecological damage may occur when air pollutants come into direct contact with vegetation or when animals inhale them. Pollutants can also settle out of the air onto land and water bodies. From the soil, they can wash into waterways, or be taken up by plants and animals. Poor air quality can also affect our climate.

These effects of poor air quality on human health and the environment can, in turn, have negative economic impacts in terms of hospitalization and medical treatments, premature deaths, and lost work days. Damage to soils, vegetation, and waterways may reduce the productivity of our agriculture and forestry industries.

The primary source of air pollution is the combustion of fossil fuels in vehicles, industries, power plants, and the burning of municipal solid waste. However in AJ&K main sources are human activities in particular vehicular emissions, wood combustions and other domestic activities including burning of wastes in open air. People of AJ&K live in areas where urban smog, particle pollution, and toxic pollutants which can pose serious health concerns are still not very evident.

2. Causes of Air Pollution in AJ&K

The main causes of pollution of air in AJ&K are described as under[1]:

1. **Emissions from industries and manufacturing activities:** Manufacturing industries, garbage burnings in open air are responsible for emitting high levels of carbon monoxide, organic compounds, and chemicals into the air.
2. **Burning Fossil Fuels:** Transportation has become a key part of everyday life in AJ&K. Cars and heavy duty trucks, and airplanes all burn lots of fossil fuels to work. Emissions from automobile engines contain both primary and

[1] Government of AJ&K, EPA, State of Environment Report, 2018 (Draft), IUCN Pakistan

secondary pollutants. This is a major cause of pollution and one that is very difficult to manage. This is because people rely heavily on vehicles and engines for transporting people, good and services. Fumes from car exhausts contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. On their own, they cause great harm to people who breathe them. Additionally, they react with environmental gases to create further toxic gases.

3. **Household and Farming Chemicals**: Crop dusting, fumigating homes, household cleaning products or painting supplies, over the counter insect/pest killers, fertilizer dust emit harmful chemicals into the air and cause pollution. In many cases. These are common practice in most of AJK areas.

4. **Garbage Burning in Open Air:** This is very common cause of pollution in developing and under-developed countries and AJ&K is no exception. Proper garbage disposal systems are not operational in AJ&K. Landfill sites are not properly located and garage burning is often resorted to by the cleaning staff. This adds to pollution of the ambient air with toxic chemicals, smell and particulate matter.

5. **Indoor Air Pollution**: This includes smoking and using synthetic building materials, smells from household care and furnishing chemicals etc. The pollutants may include pollen, tobacco smoke pesticides, radon, asbestos and carbon monoxide trapped inside the buildings. The Government has strictly banned smoking in all public buildings.

3. Current Status of Ambient Air Quality

Air pollution contributes to acidification and global climate change, which have an impact on crop productivity, forest growth, biodiversity, cultural monuments and many aspects of the national economy. The primary source of air pollution is the combustion of fossil fuels in vehicles, industries, power plants, and the burning of municipal solid waste. In AJ&K main sources of pollution in air are human activities in particular vehicular emissions, wood combustion for energy and cooking and other domestic activities. High levels of air pollutants cause all kinds of respiratory problems and irritation of the eyes. Long-term exposure to air pollution can cause cancer and damage to the immune, neurological and reproductive systems.

No systematic study has been done to monitor and quantify the ambient air quality due to various sources. Results of a study conducted in 2010 on ambient air quality are summarized in annex 7. Data show that the levels of pollution of NO_x and SO_2 are within the WHO and US EPA limits and the NEQS. Overall CO_2 level in AJ&K is lower than the NEQS values. Noise levels measured were within the NEQS limits. Ozone concentrations measured were also within the limits. Volatile Organic Compounds (VOCs) measured in this study were also on the lower side with only a few spike values. Bio-aerosols were also on a very lower side as compared to the studies conducted in other parts of the country.

However, the ambient air in AJ&K, particularly in urban areas is generally of poor quality due to high emissions from both stationery and mobile sources. These include generators, leakages from gas transmission lines, vehicles, and burning of wood, and trash, etc. The vehicular emission comprise of a wide variety of

pollutants, principally carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of Sulphur and VOCs.

4. State of the Environment of Ambient Air

A DPSIR analysis of the state of the environment of ambient air in AJ&K is as follows:

4.1 The Drivers

Rapid population growth and unplanned urbanization in AJ&K together with increase in automobiles are exacerbating the urban pollution. The main drivers of air pollution in AJ&K are identified as:

1. Burning Fossil Fuels: Emissions from automobile engines contain both primary and secondary pollutants and contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. Another source of emissions from burning fossil fuel is the widespread use of small diesel electric generators in commercial and residential areas due to frequent and prolonged power outages.
2. Emissions from Industries and Brick Kilns: Industrial facilities, particularly those consuming fossil fuels, emit significant amounts of air pollutants. The industrial base of AJ&K is not well developed, however, a wide range of small scale to medium-scale industries, including brick kilns, plastic molding, steel re-rolling, food and beverages, leather and shoe, textile, etc. contribute substantially to urban air pollution through their use of “waste” fuels, including old tires, paper, wood, coal, and textile waste.
3. Garbage Burning in Open Air: This is very common cause of pollution in developing and under-developed countries and AJ&K is no exception. Proper garbage disposal systems are not operational in AJ&K, which leads to the burning of garbage in open air.
4. Household and Farming Chemicals: All kinds of fertilizers, pesticides and insecticides, fumigating agents, household cleaning products, paints emit harmful chemicals into the air and cause pollution. Use of these products is growing and has become a common practice in most urban and rural areas of AJ&K mainly for promoting agriculture in the State, but also for maintaining houses and other structures.
5. Indoor Air Pollution: Indoor pollution results from smoking and using synthetic building materials and furnishing chemicals etc. The pollutants may include tobacco smoke pesticides, radon, asbestos and carbon monoxide trapped inside the buildings.

4.2 The Pressures

The drivers identified above develop a number of pressures on the environment, which are described hereunder.

1. **Air Pollution:** Some air pollution is visible, like suspended dust and smoke particles, while many of the greenhouse gas emission from industry and transport are invisible. The air pollution impairs the air quality and quality of life. There is high air pollution in most urban areas of AJ&K.

2. **Hotter and Drier Summers**: Greenhouse gases are a major cause of global warming, and AJ&K has been experiencing hotter and drier summer. In addition, there are many extreme heat events during the summer. Conversely, the winters are usually milder with occasional cold events.

3. **Haze**: Haze and smog hanging over cities from suspended particulate matter is the most familiar and obvious form of air pollution. This is caused when sunlight encounters tiny pollution particles in the air. Haze obscures the clarity, colour, texture, and form of what we see. S. In AJ&K, incidence of haze in areas close to urban centers is quite common which is indicative of presence of heavy amounts of particulate matter in air caused by burning of wood, garbage in open areas and nearby brick kilns.

4.3 The State

Fortunately, Aazd Jammu & Kashmir because of its high natural green cover, and relatively smaller urban footprint, the ambient air is relatively cleaner than in most of the cities of Pakistan. However, there are signs of deteriorating air quality near the industries and particularly stone crushing plants. The last study on assessing air quality was conducted over 7 years back but that was rather limited to a few parameters only. Since then the things have changed rapidly and no updated information is available on the status of ambient air quality. Based on the foregoing and scanty data that is available, observations and discussions with public and private sector stakeholders, the overall state of environment of the Ambient Air can be termed as “Good” though with a declining trend.

State of Environment – Ambient Air

State				
Excellent	**Good**	**Moderate**	**Poor**	**Bad**
		☑		
Trend				
Improving	**Stable & Improving**	**Stable**	**Stable and declining**	**Declining**
				↘

4.4 The Impacts

The likely impacts on the air quality in future, if no action is taken to address the issues and bring about an overall improvement, are described in the following sections.

1. **Human Health:** Air pollution can harm human health when it accumulates in the air in high enough concentrations. People exposed to high enough levels of certain air pollutants may experience: irritation in the eyes, nose, and throat, wheezing, coughing, chest tightness, and breathing difficulties, worsening of existing lung and heart problems, such as asthma, increased risk of heart attack. In addition, long-term exposure to air pollution can cause cancer and damage to the immune, neurological, reproductive, and respiratory systems. In extreme cases, it can even cause death.

2. Biodiversity: At present there is little or no noticeable impact on biodiversity. There has not been any investigation of impacts of air pollution in AJ&K on biodiversity. However, emissions of nitrogen oxides from cars, trucks, and other sources may contribute to the addition of nitrogen entering aquatic ecosystems which may lead to Eutrophication. Studies have shown that air toxics are contributing to birth defects, reproductive failure, and disease in animals. Persistent toxic air pollutants (those that break down slowly in the environment) are of particular concern in aquatic ecosystems. These pollutants accumulate in sediments and may bio-magnify in tissues of animals at the top of the food chain to concentrations many times higher than in the water or air. Ground-level ozone can lead to reductions in productivity of crop and trees, survival of tree seedlings, and increased susceptibility of plant to disease, pests and other environmental stresses.

4.5 The Response

Barring urban centers like Muzaffarabad and Mirpur, air quality in AJ&K currently does not face serious challenges of pollution as a whole. However, the rapid development activity in the infrastructure and energy sectors is posing some problems at the micro level which, if left unchecked, might become a serious problem that would necessitate proper response at different levels. AJ&K is fortunate in having a good green cover over most landscapes and in town/cities, which has prevented widespread deterioration of air quality. The response of the State is through the State Environmental Protection Agency.

Though legislative measures have been taken and standards are in place, the implementation of rules and regulations is a grey area that needs attention. Lack of proper monitoring of air quality is a serious handicap. On ground, the response still has to see the light of the day.

5. Development Strategies

Measures such as conversion of vehicles to no lead gasoline and low sulfur diesel have been implemented but remain insufficient to prevent deterioration in ambient air quality in the urban areas due to increasing vehicle numbers and their hazardous emissions. Indoor air pollution is a major cause of widespread chronic bronchitis and other respiratory infections in rural households and poor urban households that depend on biomass for cooking and heating particularly in winters.

5.1 Strategic Objectives:

1. Improve Air Quality Monitoring and Forecasting System;
2. Establish functional data base of information on air quality with easy access by public;
3. Raise general public awareness on clean air and environment to help promote the concept of clean production in industries and fuel efficient technologies in the industrial, transport and domestic sectors; and
4. Integrate environmental considerations in the Planning Process

5.2 Strategies to Achieve Objectives

Objective 1:

1. Establish a well-designed monitoring network with upgraded PM10 and PM2.5 monitoring equipment and capability to cover the whole of AJ&K;
2. Establish mobile air quality monitoring laboratories in Muzaffarabad and Mirpur for monitoring air ambient quality and to respond to specific pollution events or complaints respectively in northern and southern parts;
3. Facilitate the development of a joint industry-funded monitoring station in industrial affluent areas like Mirpur;
4. Identify areas of potential high exposure to population due to air toxics and conduct monitoring programs where necessary;
5. Develop an Air Pollution Potential Atlas for the State of AJ&K identifying areas likely to have poor air dispersion to facilitate better air quality management;
6. Develop and implement a smoke monitoring plan in various urban centers; and
7. Introduce new technologies in brick kilns.

Objective 2:

1. Gather data on the main sources and types of air pollutants and the trends in the type of home heating systems used and estimate emissions of PM10 and PM2.5 from domestic and small industrial sources and agriculture related activities.
2. Establish a database of pollutants and their temporal trends in various parts of AJ&K.. The database should have: (a) GIS based interactive maps, (b) website that is regularly updated with real-time data.

Objective 3:

1. Develop and run long term program of mass awareness for general public including gender, industrialists, public transporters, and brick kiln owners;
2. Conduct market research to monitor trends towards less polluting alternatives and barriers to conversion to alternative forms of domestic cooking and heating;
3. Undertake a study on providing incentives to help promote and adopt improved technologies for heating, cooking and baking clay bricks. This would include subsidies/tax free rates for new efficient technologies.

Objective 4:

1. Sensitize and build the capacity of technical and management staff of all concerned departments on Integrated Air Quality Management (IAQM) through sensitization and capacity building events.
2. Prepare guidance material to assist in integrating air quality considerations into the development and implementation of planning schemes in the industrial and transport sectors.

WATER IS THE ISSUE!

Dr. Moonis Ahmar

There is no other country in South Asia than Pakistan which is facing three-pronged threat because of a serious water crisis. First, on January 17, in a debate on water crisis, several members of the Sindh Assembly accused the federal government of usurping the water rights of Sindh province and held the Indus River System Authority (IRSA) responsible for transforming their province into a barren land. Second, sandwiched between India in the east and Afghanistan in the west, Pakistan's water predicament is deepening with each passing day. Third, India has built dams and barrages on the rivers Jhelum and Chenab in its controlled parts of Jammu and Kashmir, whereas New Delhi is assisting Afghanistan to construct hydropower projects and dams on the Kabul River. The World Bank is also reported to have expressed its interest to provide $7.079 billion for the construction of 12 dams on the Kabul River.

If India intends to deprive its western neighbour of its legitimate water rights guaranteed under the i960 Indus Waters Treaty, its policy to engage Afghanistan in exerting pressure over Pakistan by reducing the flow of the Kabul River will certainly add to Islamabad's water predicament in the days to come. How the Indian water strategy and diplomacy is perceived as a major threat by Pakistan and as a double-edged plan to augment water woes for its eastern neighbour? What should be Pakistan's response to meet what it calls India's policy to deprive it of water resources from the Indus and Kabul rivers systems? How Pakistan can deal with intra water conflicts, particularly between the provinces of Sindh and Punjab?

Pakistan and Afghanistan share nine rivers with annual flows of around 18.3 million acres feet (MAF), of which the Kabul River accounts for 16.5 MAF. Another river which is shared by Pakistan and Afghanistan is the Chitral River which originates in Pakistan and contributes 8.5 MAF, butwhen it enters Afghanistan this river is called the Kunar River. Unlike India and Pakistan where the Indus Waters Treaty as a legal document determines the water distribution for the two countries, there is no such water treaty between Pakistan and Afghanistan despite the fact that Islamabad has been urging Kabul to sign a bilateral treaty on the distribution of water resources shared by the two countries. As a lower riparian state, Pakistan has a right to get its share of water from the Kabul River inasmuch as the upper riparian state on the Chitral River Pakistan can use the water of that river but when that river enters Afghanistan from Pakistan, as a lower riparian state Afghanistan has a right to use its share of water from that river.

Pakistan's double water jeopardy is compounded because of three main reasons;

First, the failure of Pakistan to build mega dams in the last 45 years. The last mega dam, Tarbela, was built in 1974 whereas it could have constructed Kalabagh Dam on the Indus River and Munda Dam on the Kabul River. The only dam which has been built on the Kabul River is Warsak Dam which is insufficient to meet irrigation

and energy needs because it generates only 500 megawatts of electricity and irrigates 119,000 acres ofland. IfIndia can help build 12 hydropower projects with a capacity to generate 1,177 megawatts of electricity and 4.7 MAF of water for irrigation from the Kabul River, why has Pakistan not been able to proceed in the direction of making use of the Kabul River for power generation and irrigation by constructing dams? Paradoxically, if China and India have built hundreds of dams for power generation and irrigation, Pakistan has been unable to build mega water reserves over a period of last four decades which tends to deepen the scarcity of water resources. Kalabagh Dam, which was to be constructed on the confluence of the Indus and Kabul rivers, has been made so controversial that some political parties from the provinces of Sindh and

Khyber-Pakhtunkhwa (K-P) are not even ready to listen to any argument in its favour. Approximately 145 MAF of water is available in Pakistan during the monsoon season out of which 106 MAF is used for irrigation through canals and the rest either evaporates or falls into the sea. Pakistan's case against Afghanistan building dams on the Kabul River is weakened because it has not focused on making use of the availability of 16.5 MAF of water from the Kabul River.

Second, if India has successfully built barrages and dams on the three rivers given to Pakistan under the Indus Waters Treaty i.e. Indus, Chenab and Jhelum knowing that it was violating the treaty, how can Pakistan prevent New Delhi from helping Afghanistan construct 12 dams on the Kabul River? India is not only helping Afghanistan in constructing dams on the Kabul River but according to reports there are plans to build sub-basin four more dams on the Kabul River which include the $72 million Haijana project (72MW) with water storage capacity of 178,420 acres feet; $207 million Kajab (15MW) project with water storage capacity of 324,400 acres feet; the $356 million Tangi Wadag (56MW) project with capacity to store 283,850 acres feet; and $5im Gat (86MW) project with water storage capacity of 405,500 acres feet

Third, if several dams on the Kabul River are being built in Afghanistan, it may have a devastating impact on Warsak Dam as its main source of water is the Kabul River. The cut in the flow of water of the Kabul River will also prevent Pakistan from constructing dams in future on the tributaries of the Kabul River, including the Kalabagh, Mohmand and Munda dams. Pakistan's predicament on current water crisis is further deepened because water availability has dropped to an alarming 1,200 cubic meters today from 5,650 cubic meters per person couple of decades ago. It is feared that if Pakistan fails to conserve water and build water reservoirs then by 2025, as warned by the Pakistan Council of Research in Water Resources (PCRWR), the country will approach absolute water scarcity. According to a report by the International Monetary Fund (IMF), Pakistan ranks third amongst countries facing water shortages. Such type of forecasts and predictions about Pakistan running out of its water resources in coming years has sent Shockwaves in the corridors of power which prompted the Supreme Court and the Prime Minister to establish a fund for the construction of Diamer-Bhasha and Mohmand dams.

The Indus River System Authority is supposed to deal with the distribution of water among provinces and often in meetings of IRSA, Sindh accuses Punjab of taking its share of water vehemendy denied by Punjab.

The need is to establish a mechanism in Pakistan to deal with intra-water issues so that the year 2025, which is called 'ground zero', is averted. Not only can building more water reservoirs on suitable locations help Pakistan successfully deal with a severe water crisis, it can also help it cope with the challenge of the India-Afghanistan nexus as far as depriving Pakistan of Indus and Kabul river water system is concerned.

In a nutshell, the solution to the three-pronged threat emanating from a severe water crisis rests with Pakistan as by utilising optimum human resource one can expect the country to successfully deal with the threat of ground zero' in 2025. Proper conservation of water and augmenting the tree plantation drive will also help overcome water crisis in the country. Besides, effectively fighting its case at the international level against the alleged violation of the Indus Waters Treaty by India needs to be rigorously and wisely pursued.

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

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Abstract:

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

Introduction

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A Case Study of Pakistan:

Leachate Analysis

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

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

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

Table 1: Analysis of leachate and groundwater quality

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

Groundwater Analysis:

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

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

Pearson Coefficient of Correlation between shallow water and leachate-1

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

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

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

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

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

Pearson Coefficient of Correlation between moderate level water and Leachate

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

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

Pearson Coefficient of Correlation between Deep level water and Leachate

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

Conclusion:

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

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