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EDITORIAL China Pakistan Corridor 1

NEWS

- Welcome Address by Engr. Iftikhar Ahmad President at 73rd Session of the Pakistan Engineering Congress 3
- Inaugural Address by Honorable Mian Muhammad Yawar Zaman, Minister for Irrigation, Punjab at 73rd Annual Session. 6
- Pictorial Glimpses of the Annual Session Proceedings 8
- Welcome Address by Engr. Iftikhar Ahmad President Pakistan Engineering Congress at the Annual Symposium 40
- Inaugural Address by Engr. Barkat Ali Luna Chairman NDC (Pvt.) Ltd. 43
- Pictorial Glimpses of Annual Symposium. 46
- Detailed Recommendations Offered by the Speaker 61
- Solar Tariff Cut By 27 Percent For New Plants 68
- Tarbela-4 Extension To Be Completed In June 2017 70
- China Approves Loan For Thar Coal Mining, Power Plant 71
- Mangroves To The Rescue 73
- Kalabagh Dam The Only Solution To Water, Energy Crisis 74
- Uncertain Clime 75
- Well Come to New Members 77

TECHNICAL PAPERS

- Development of Malaysia's National Annex to Eurocode on Earthquake Resistance 78
- Planning & Design Concept of Man-made/Artificial Beaches in Coastal Urban Areas By Engr. M. P. Aftab 85
- Groundwater Recharge Estimation in on Irrigated Area- A Case Study of Rechna Doab, Punjab, Pakistan By Ghulam Zakir Hassan, Dr. Engr. Abdullah Yasar, Saleem Akhtar, Faiz Raza Hassan 90

FOR MEMBERS ONLY

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

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[1] Engr. Malik Ata-ur-Rehman Passed Away on 2nd February 2015.



Engr. Iftikhar Ahmad
President
Pakistan Engineering Congress

EDITORIAL

China Pakistan Economic Corridor (CPEC): "*A development Catalyst for the Region*"

The CPEC is an ongoing development mega project which aims to connect Gwadar Port of Pakistan to China's northwestern region of Xinjiang, via a network of highways, railways and pipelines. The corridor is considered central to China–Pakistan relations and will run about 2,500 km from Gwadar to Kashghar. The aim is to create linkages between the Western Region of China and Pakistan by establishing communication links and developing Trade Corridors that would facilitate economic activity along the corridors. China-Pakistan Economic Corridor and its connectivity with Central Asia, Middle East and Africa will help re-shape the entire region. Overall construction cost is estimated to be around $46 billion.

The investment on the corridor will transform Pakistan into a regional economic hub. The corridor will be a confidence booster for investors and attract investment not only from China but other parts of the world as well. Besides the high speed, access control road transport facilities, the corridor will provide Pakistan with telecommunications and energy infrastructure. The CPEC energy projects will serve as a backbone of the energy strategy to overcome power crisis and encourage industrialization in the country on sustainable basis. The table below show estimated investment in each component:

Projects	Estimated Cost: US$ Millions
Energy	34,413
Transport and Infrastructure	
Roads	6,100
Rail Network	3,690
Gwadar Port	793
Others	44
Total	**45,040**

(Source: Ministry of Planning, Development & Reforms, GoP)

The corridor will strategically connect the two countries and would facilitate shipping millions of tons of goods from China to the Middle East, Africa and Europe via the Gwadar port. The construction of oil and gas pipelines through the corridor will help meet energy needs of China and Pakistan alike. The corridor initiative is strategically and economically more beneficial to China, as the distance and time to ship its goods to the Middle East, Africa and Europe will be substantially reduced. Moreover, the corridor will act as a source of connectivity between East Asia and South Asia, as well as the Gulf and the Middle East. With a length of around 3,000 kilometers from

Kashgar to Gwadar and with US $46 billion Chinese investments, a turnaround of backward and less developed regions of both Pakistan and China is expected. Pakistan, located at the crossroads of Central and West Asia, the Persian Gulf and the Middle East holds a strategic position, and CPEC will further augment that position.

WELCOME ADDRESS

By

ENGR. IFTIKHAR AHMAD

PRESIDENT

On

73rd ANNUAL SESSION

Pakistan Engineering Congress

- Honorable Chief Guest **Mian Muhammad Yawar Zaman sahib**,

  Minister for Irrigation, Punjab
- Distinguished Delegates,
- Fellow Engineers,
- Ladies and gentlemen!

اسلام علیکم ورحمتہ اللہ و برکاتہ

It is a great honourand indeed a proud privilege for me to welcome you all on behalf of the Pakistan Engineering Congress to its 73rd Session. The significance of this Session has increased manifold as we are inaugurating our session on this auspicious day of 12 Rabi ul Awwal.

The Congress, established in the year 1912, is the oldest body of the professional engineers of the Sub-Continent. Major objectives of the Congress are development, propagation and promotion of engineer's knowledge and practices for the advancement of the engineering profession and augmenting their efforts for national development. 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 Government for considerations. A large number of Papers presented at the Congress platform have won world-wide recognition and acclaim. Many advances made in the fields of various engineering disciplines, were first presented at the platform of this

Congress. Over the past 100 years as many as 1069- technical papers have been presented and discussed. 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.

Ladies and Gentleman

The Congress continues to strive and provide opportunities to expand engineering knowledge, by discussing engineering issues, new technologies, and coming up with recommendations. In doing so it also regularly observes the "World Water Day" and "World Environment Day" where presentations are made to create awareness amongst the masses about these vital resources and their conservation.

"Engineering News", a quarterly journal of the Pakistan Engineering Congress is being published since 1958. Proceedings of all the technical papers and the Quarterly Journal are distributed complimentary to various institutions, engineering universities and to the libraries, local as well as foreign to further the cause of development, exchange the dissemination of various technical knowledge of a broad spectrum over the largest possible area.

Ladies and Gentleman

The Congress endeavors to disseminate engineering knowledge and practices amongst its members and the engineering associates at large. Thus, the website of the Congress **Error! Hyperlink reference not valid.** an engineering treasure trove, which includes:

749-Technical Papers covering all aspects of engineering disciplines spread over 73 volumes (1912 to-date)

320 -Symposium papers on issues of national importance spread in 37-volumes.

Quite a significant number of technical papers presented at these proceedings are internationally acclaimed and frequently referred to by the engineering community.

Ladies and Gentleman

During this 73rd Session, ---- technical papers covering various important subjects shall be presented. A Symposium on the subject of "***Means of Transportation-Present & Future***" is also being held as part of this Annual Session.

Seminars on several important technical issues were held during the years 2014-2015 besides visit of delegates to the Projects of national importance.

Ladies and Gentleman

The Pakistan Engineering Congress also attaches great importance to the promotion of profession and welfare of professional and engineering community.

Accordingly, the scholarship program of the Pakistan Engineering Congress was launched in the year 2005-2006. It is a unique program under which 544 scholarships have been awarded for full 4 year span of graduate studies, which tantamount to 2176 scholarships.

In addition 200 scholarships for MS engineering studies have been awarded in 2014-2015.

Honourable Mian Muhammad Yawar Zaman Sahib

While highlighting our efforts from the platform of Pakistan Engineering Congress and our humble contributions,it is also important to share the ever increasing concern and frustration amongst the public sector engineering community for the lack of proper service structure and career paths .It is therefore, that the Pakistan Engineering Congress has been advocating better service conditions and structure for the engineers in Government services at least at par with other services. A five-tier services structure plan was proposed by the Congress and was sent to the Government and despite being agreed in Public pronouncements by the then Prime Minister, has yet to be implemented.

We expect that again your kind-self will use your good offices to impress upon the Federal and Provincial Governments to implement the five-tier services structure and scheme of time-scale promotions for engineers as has been done in the case of some other professions.

In the end, *Sir*, I extend sincerest gratitude on behalf of the Executive Council of Pakistan Engineering Congress, Engineering Community in general and on my own behalf in particular, for your presiding over the inaugural session of this event and making it a source of encouragement for the Engineers of Pakistan and thanks to all the audience for a very patient hearing.

Pakistan Paindabad

INAUGURAL ADDRESS

by

Honorable Mian Muhammad Yawar Zaman

Minister for Irrigation, Punjab

At the

73rd Annual Session

Of

PAKISTAN ENGINEERING CONGRESS

President Pakistan Engineering Congress!

Distinguished Guests,

Members of the Congress

Ladies and Gentlemen!

Assalam o Alaekum!

I feel it a great honor to address such a gathering of the luminaries of engineering profession on the auspicious occasion of 73rd Annual Session of the Pakistan Engineering Congress. The Congress is a formidable institution that is performing a great job in the field of education. The award of 2176 scholarships for graduate engineering studies and 200 Scholarships for M.S. Engineering studies over the years is a unique service and the performance of the Congress deserves high appreciation for it.

Ladies and Gentlemen!

The Congress has also been playing an instrumental role in the dissemination of engineering knowledge, Technical papers are presented at the Annual Session as is being done in the present session. The number of technical papers pointed out in the address of welcome comes to a staggering figure of 1069. It is a great contribution and service to the engineering profession and execution of construction projects of National importance as this information is available at Congress website and is being consulted by the engineers from time to time.

Ladies and Gentlemen!

Regarding the symposium being held along with the Annual Session on the topic of “Means of Transportation – Present and Future” is very apt. The government is already ceased with the issues of improvement in the field of transportation and the mega projects like Metro and Orange line will go a long way in the economic development of the Country. The recently concluded Pak China Economic Corridor Accord is also going to usher a new chapter of advancement in means of transportation in Pakistan.

Ladies and Gentlemen!

Regarding the issue of implementation of five tier “Service Structure” and scheme of “time scale promotion” for engineers brought out by the President of the Congress, I would request that the relevant papers may be furnished to me. I assure you of my sincere efforts in this respect.

Ladies and Gentlemen!

In the end, I congratulate Pakistan Engineering Congress for contributing immensely in the elevation and uplift of engineering knowledge by arranging seminars, lectures and symposia on current issues faced worldwide. I hope the recommendations put forward would be enormously valued and practiced.

Pakistan Paindabad

The 73rd Annual Session
of
Pakistan Engineering Congress
December 24th, 2015



(From left) Engr. Dr. Izhar ul Haq, V.P., Engr. Syed Mansoob Ali Zaidi, Secretary-PEC, Engr. Iftikhar-ul-Haq, Member E.C., Engr. Ch. Ghulam Hussain, V.P., Engr. Husnain Ahmad, V.P./Past President (PEC) & Engr. Anwar Ahmad, Member PEC.



(From Right) The Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab, upon arrival at P.C.Hotel, Lahore, being received by Engr. Syed Mansoob Ali Zaidi, Secretary-PEC



(From Left) Engr. Husnain Ahmad, V.P./Past President (PEC), Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab, Engr. Dr. Izhar ul Haq, V.V.P., Engr. Ch. Ghulam Hussain, V.P.



Engr. Husnain Ahmad, V.P./Past President (PEC) introducing Members of the Executive Council of Congress to Chief Guest The Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab



Group Photo of the Executive Council of Pakistan Engineering Congress with Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab



(From Left) Engr. Iftikhar Ahmad, President Pakistan Engineering Congress, Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab and Engr. Syed Mansoob Ali Zaidi, Secretary-PEC



Engr. Iftikhar Ahmad, President Pakistan Engineering Congress delivering the Welcome Address at the event



Engr. Syed Mansoob Ali Zaidi, Secretary-PEC proceeding with the Programme of the 73rd Annual Session



Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab delivering the Inaugural Address



(From left) Engr. Iftikhar Ahmad, President Pakistan Engineering Congress presenting the Souvenir to Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab



Engr. Ch. Muhammad Rashid Khan and Engr. Riaz Ahmad Khan, Past Presidents of the Congress, presiding over the Technical Session



(From Right) Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab in a discussion with Engr. Husnain Ahmad, V.P. / Past President PEC



(From Right) Chief Guest the Honorable Mian Muhammad Yawar Zaman, Minister of Irrigation, Punjab in a discussion with Engr. Husnain Ahmad, V.P. / Past President PEC, Engr. Akhtar Abbas Khawaja, V.P. and Engr. Najam Waheed, Member E.C.



Engr. Ch. Muhammad Rashid Khan Past President of the Congress and Engr. Iftikhar-ul-Haq awarding shield to Engr. Riaz Nazir Tarar for presenting his paper on the topic of “Pakistan’s Water Security Issues and Addressing Strategy”



Engr. Ch. Muhammad Rashid Khan and Engr. Iftikhar-ul-Haq awarding shield to Engr. Ch. Abdul Khaliq for presenting his paper on the topic of "*Water Security Issues and Way Forward"*



Engr. Ch. Muhammad Rashid Khan and Engr. Iftikhar-ul-Haq awarding shield to Engr. Dr. Izhar-ul-Haq for Chairing the Technical Session.



Engr. Ch. Muhammad Rashid Khan and Engr. Iftikhar-ul-Haq awarding shield to Engr. Dr. Mahmood Ahmad for presenting his paper on the topic of "*Water Policy Issues and Options: Some Ideas to use Economic Tools to close the Growing Supply and Demand Gap*"



Engr. Syed Mansoob Ali Zaidi, Secretary PEC and Engr. Ch. Muhammad Rashid Khan awarding shield to Engr. Iftikhar-ul-Haq, Member E. C. for chairing the Technical Session.



(From Left) Engr. Riaz Nazir Tarar, Engr. R. K. Anver, V. P. (PEC), Chairman of the Technical Session & Engr. Akhtar Abbas Khawaja, V.P. (PEC)



Engr. R. K. Anver, Vice President, Pakistan Engineering Congress expressing his views on the Papers presented at the Technical Session.



(From Right) Engr. R. K. Anver, Vice President, PEC awarding shield to Mr. Tariq Altaf, for presenting his paper on the topic of "*Hill Torrents of Pakistan*"



(From Right) Engr. R. K. Anver, Vice President, PEC awarding shield to Mr. Abdul Khaliq Hashmi, for presenting his paper on the topic of "*Hill Torrents of Pakistan*"



(From Right) Engr. R. K. Anver, Vice President, PEC awarding shield to Engr. Akhtar Abbas Khawaja, V.P. (PEC) for chairing the Technical Session.



(From Right) Engr. R. K. Anver, Vice President, PEC awarding shield to Mr. Yawar Hamid, for presenting his paper on the topic of "*Capturing the Flood Waters*"



(From Right) Engr. R. K. Anver, Vice President, PEC awarding shield to Engr. Riaz Nazir Tarar for chairing the Technical Session.

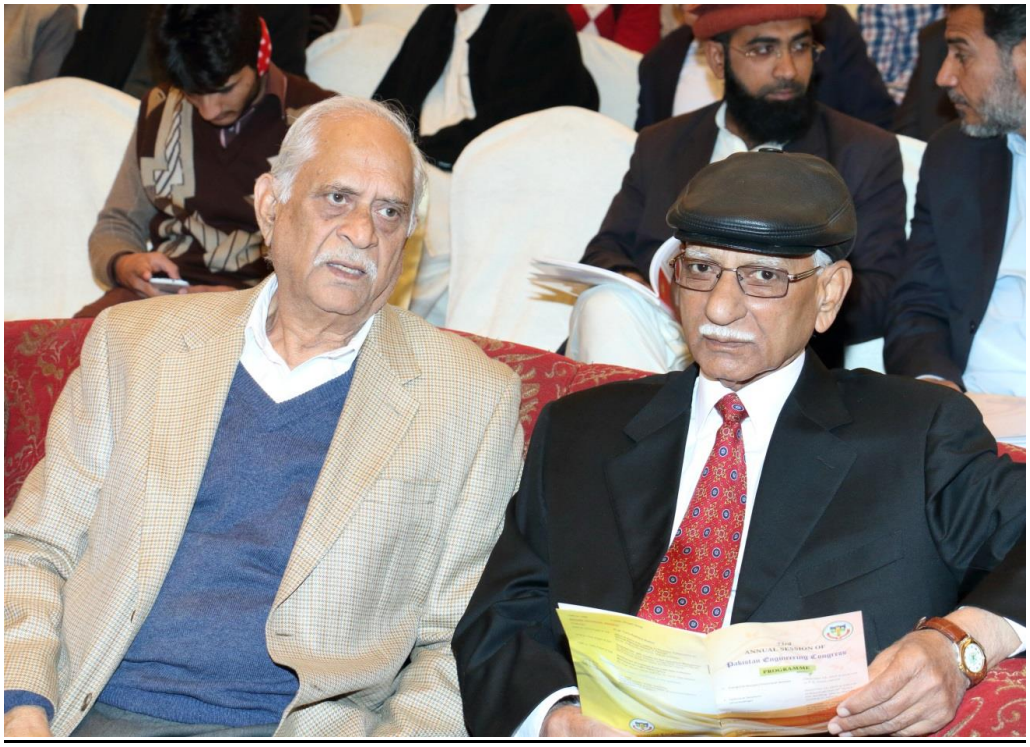
Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience



(From Left) Engr. Riaz Ahmad Khan, Engr. R.K. Anver, Engr. Ch. Muhammad Rashid Khan, Engr. Ch. Ghulam Hussain, Engr. Dr. Izhar-ul-Haq,



(From Left) Engr. Husnain Ahmad, V.P / Past President (PEC) Third Left Engr. Barkat Ali Luna

Glimpses of the Audience



(2nd From Left) Engr. Ijaz Ahmad Cheema Member E.C and Engr. Capt. (R) M. Qadir Khan Member E.C



Glimpses of the Audience





December 25th, 2015



Engr. Ch. Ghulam Hussain V.P (PEC) expressing his views at the event.



(From Right) Engr. Abdul Khaliq Khan, Session Chairman, awarding shield to Mr. Mohammad Ashraf for presenting his paper on the topic of "*Irrigation Scheduling*"



(From Right) Engr. Abdul Khaliq Khan, Session Chairman, awarding shield to Mr. Mushtaq Ahmad Gill for presenting his paper on the topic of "*On-Farm Water Storage*"



(From Right) Engr. Abdul Khaliq Khan, Session Chairman, awarding shield to Mr. Ishteqaq Ahmed Kokab for presenting his paper on the topic of "*Water Security for Sustained Development of Pakistan"*



(From Right) Engr. Abdul Khaliq Khan, Session Chairman, awarding shield to Mr. Ghulam Zakir Hassan Sial for presenting his paper on the topic of "*Groundwater Management Using Modflow- A Case Study Of Rechna Doab, Punjab, Pakistan"*



(From Right) Engr. Muhammad Arif, V.P. PEC, awarding shield to Engr. Abdul Khaliq Khan for chairing the Technical Session



(From Right) Engr. Riaz Nazir Tarar, Session Chairman, awarding shield to Mr. Abdul Wahab Kakar for presenting his paper on the topic of "*Rain-Water Harvesting*"



(From Right) Engr. Riaz Nazir Tarar, Session Chairman, awarding shield to Mr. Abdul Rehman Ch. for presenting his paper on the topic of "*Rail Link between Pakistan and China-Pre-Feasibility Study"*



(From Right) Engr. Riaz Nazir Tarar, Session Chairman, awarding shield to Mr. Sajid Rashid Ahmad for presenting his paper on the topic of “Geomorphological and Geological Investigation using Dem of Islamabad District, Pakistan”



(From Right) Engr. Riaz Nazir Tarar, Session Chairman, awarding shield to Ms. Wajeha Tauqir for presenting her paper on the topic of “Modeling of Chlorine Decay in NUST Drinking Water Distribution System”



(From Right) Engr. Ch. Ghulam Hussain V.P (PEC) conferring shield on Engr. Riaz Nazir Tarar for chairing the Technical Session



(From Right) Engr. Ch. Ghulam Hussain conferring shield on Prof. Dr. Shahid Munir presenting his Paper on the topic of *"Coal Exploitation and Utilization for Economic Development"*



(From Right) Dr. Izhar-ul-Haq conferring shield on Dr. Engr. Muhammad Saeed for presenting his Paper on the topic of *"Groundwater Pollution and Threat for Environment in Mega City Faisalabad"*



(From Right) Dr. Izhar-ul-Haq conferring shield on Engr. Muhammad Muneeb Khan for presenting his Paper on the topic of *"Instream Hydrokinetic Power Technology – A Case Study of Ghazi Barotha Channel"*



(From Right) Engr. Iftikhar Ahmad, President Pakistan Engineering Congress conferring shield on Engr. Dr. Izhar-ul-Haq for presenting his Paper on *the* topic of *"Water Security Issues and Way Forward"*

Glimpses of the Audience



(Above From Right) Engr. Iftikhar Ahmad, President Pakistan Engineering Congress, Engr. Ijaz Ahmad Cheema, Member EC (PEC) and Engr. Riaz Nazir Tarar



(From Left) Engr. Riaz Nazir Tarar, and Engr. Dr. Izhar-ul-Haq

Glimpses of the Audience



**(From Right) Eng. Hussnain Ahmad, Eng. R.K Anvrt,
Eng. Ch-Ghulam Hussain & Eng. Dr Ijaz-ul-haq**



Glimpses of the Audience





Welcome Address by

Engr. Iftikhar Ahmad

President Pakistan Engineering Congress

At the

Annual Symposium

On the topic of

"**Means of Transportation-Present and Future**"

The Honorable Chief Guest, **Engr. Barkat Ali Luna,**

Distinguished Engineers,

Members of Pakistan Engineering Congress,

Ladies & Gentlemen,

Asalaam-o-alaikum!

On behalf of Pakistan Engineering Congress, it is a great pleasure and honour for me to offer a warm welcome to this prestigious gathering of Engineers. Your presence here today bespeaks of the keen interest shown by you in the professional activities of Engineering Congress.

Pakistan Engineering Congress is a multi-disciplinary body of professional engineers that promotes science profession and practice of engineering.

At the floor of this dignified gathering, I feel gratified to claim that most of the theories and formulae for the design of channels, barrages, regulating structures and cross drainage structures which altogether constitute the largest contiguous irrigation system of the world, were developed by the local irrigation engineers like M/s Kennedy, Lacey, Montague, Foy, Inglis, Kanwar Sain, Khawaja Ghafoor, S.I. Mehboob, Pir Ibrahim, Sh. Ahmad Hassan and Dr. S.S. Kirmani.

Since 1957, Pakistan Engineering Congress has been holding Annual Symposia regularly on different major problems, like Floods, Water salinity and other allied issues, Engineering Education, Planning and Execution of Engineering Projects and Researches in Pakistan, Problems and Solutions relating to Dams and Reservoirs, Energy Crisis, and Environmental Protection and its Conservation.

This year the significant topic of the Annual Symposium is **"Means of Transportation - Present and Future".**

Ladies & Gentlemen!

The Population of Pakistan was 34 million in 1951. It stands over 188 million as at present and is visualized to hit 217million mark by 2025. Population of the world is 7.28 billion and is visualized to be 8 billion by 2024.

The food and fiber need of this ever increasing population together with other goods & services in keeping with the rising standards of living is to be furnished globally. These goods & services need to be speedily transported to the villages, towns and cities as well as to foreign countries through Road Transport, Rail-Links, Sea-routes and Air.

The mode of Air travel has also assumed immense significance with over 3-billion people travelling by air the world over. It offers the speediest means of covering long distances.

Ladies & Gentlemen!

We are living in an inter-dependent global World. We are dependent on each other for fulfillment of our needs, which further raise our living standards. Same is the case with other nations of the World and also the main reason for the continued increase in World Trade, that is, import and export of goods and services which fuels sustained economic development. The economically advanced countries are taking full benefit of it and are investing huge funds in development of transportation network, not only in their own countries but extending transportation links globally, like:

- A 900-Km Railway Line through Turkmenistan-Kazakhstan & Iran is to be constructed, linking-up Central Asia to the countries of Persian Gulf.

- American States are investing billions of dollars on modernization/extension of highways.

- China is constructing a new Silk Road at a cost of 40 billion dollars from South-West China via Kazakhstan-Russia, Belarus and Poland-Germany to ensure speedy transportation of Goods.

- Thailand has approached Japan to construct 3-Rail links of 1500 Km to connect Capital Bangkok with its Towns cities. It has also concluded an agreement with china to construct 734 km dual track Railway.

- In present Japan, the bullet Trains travel at a speed of 200 miles per hour, to cater to 324 million commuters annually. With even higher speed to cover long distances in shortest possible duration, another ambitious project of Bullet Trains involving 100-Billion dollars is being visualized.

Ladies & Gentlemen!

The modern transport system now requires underground trains, super highways, flyovers, metro-bus services, metro trains and above all Bullet trains.

Pakistan had the singular distinction of construction of first Silk Road with the assistance of China reviving the ancient trade route with China. It has paid special attention towards construction of a Net-Work of Road-Ways, High-Ways, Under-Passes, Metro-Bus, Motor-Way lines.

The Pak China Economic Corridor (CPEC) is a land mark accord. It encourages multiple developments in the global, regional, bilateral and domestic context spanning

the breadth and width of Pakistan, and eventually linking the Pakistani city of **Gwadar Port** in southwestern to China's northwestern autonomous region, via a vast network of **highways** and **railways**. It also lays great emphasis on 'communication network' involving projects like Rapid Transit Orange line Metro & Peshawar-Karachi Motorway. The government should take full benefit out of this golden opportunity especially relating to railways and communication works.

Ladies & Gentlemen!

We are also indebted to all the speakers, who have spent a great deal of time preparing for this event, and we eagerly await their contributions. Several technical papers are being presented in today's symposium, by eminent authors covering aspects relating to Mass Transit, Inland Water-ways Navigation System, Railway Transportation, Ports & Shipping, Sustainable Truck ports, National Highway network in Pakistan, GIS/GPS System for Rail Operations and Improvements in Road Crash Data Collection Mechanism.

I believe that through discussions and exchange of views, this seminar will be steered to a fruitful conclusion and at the same time we would come to recommendations on what should be done in active contribution to our country.

Thank you all for your patient hearing.

Pakistan Paindabad

INAUGURAL ADDRESS

By

Engr. Barkat Ali Luna

Chairman

National Development Consultants (Pvt.) Ltd

At the

Annual Symposium

Engr. Ch. Ghulam Hussain, *President-Elect, Pakistan Engineering Congress, Distinguished Delegates, Participants, Ladies & Gentlemen!*

Assalam-o-Alaikum!

I deem it an honour and a duty to deliver the inaugural address to this esteemed gathering on this occasion of Symposium on the theme of "Means of Transportation – Present & Future", organized by Pakistan Engineering Congress.

Ladies & Gentlemen!

It is the prime responsibility of a welfare state to meet the food & fibre needs of its people, which are increasing at a rate of 1.4% per annum. Presently, it stands over 188 million mark and is visualized to touch 217 million mark by 2025.

Moreover, due to absence of employment opportunities and consequent migration of people from the rural areas, the phenomenon of urbanization is placing heavy burden on the cities and mega cities. The population of Karachi is staggering over 23.5 million and the same demographic pressure is on other cities. For feeding the people and meeting the needs for other goods / services, speedy, efficient and economically affordable means of transportation have to be developed.

Ladies & Gentlemen!

Pakistan is a part of a global world, and is in need of goods, machinery / equipment, fuel, medicines, edible oil etc. from other countries. Similarly, we have to export Country's agriculture products, cotton, fabrics, garments, sport goods, medical instruments, sugar, cement, leather goods etc. to earn valuable foreign exchange essentially required for meeting our foreign currency commitments. All these necessities among other things require continued build-up and maintenance of a network of roads, rails, air, and maritime links within and outside countries as amply brought out by President PEC in his address.

Ladies & Gentlemen!

The global trade is also intensifying the demand for improved and more efficient modes and models of transportation. As the industrial supply chains become more integrated, the pressure to reduce transportation and logistics costs – while maintaining the highest standards of efficiency and reliability – would drive the decision making. The harvest of natural resources as noted hereinbefore, including future

resource developments, would increase pressures on the transportation systems as well. The issues of city traffic and transport, being too integrated to the whole of this scenario, would also be required to pull to the mainstream so as to maintain a real competitive advantage for all the fruits of positive sectoral development.

Ladies & Gentlemen!

For a transportation system to remain successful and efficient, the private sector also needs to excel in its role, while respecting the boundaries that frame the related rules and regulations. The private sector should also be coordinating their actions well, to advance the activities for a common goal for positioning of the transportation system to better respond to challenges and opportunities, it would require all the related stakeholders not only to make strategic choices but also to take such actions which are taken over ahead of sound analysis and effective collaboration. We should keep it in mind that the economies of the advanced Countries have been built, expanded profitably by their private sector and the emerging economies are following in their footsteps.

Ladies & Gentlemen!

You will agree with me that Railways in Pakistan was once a centerpiece of the transportation network. It was also a symbol of the unity of the country carrying people / goods to the near and far corners at nominal cost. However due to the negligence and apathy of the planners, Railways was left behind in budgetary allocations, neglect of commercial operations and managerial efficiency of decades, it has been reduced to a non-entity. However, the efforts of the present government and as well as due to hefty cash outlay, a turnaround has started, and it is a good news for the future of the country.

Ladies & Gentlemen!

If we have to compete with the economically developed countries as well as with emerging economies to take full benefit of emerging trade / commercial opportunities, we have to pay special attention towards expansion / modernization of transportation facilities. We need a robust surface transportation system, Maritime, Air, Sub-surface transportation network with countries of the world.

Ladies & Gentlemen!

While you will be discussing “Means of Transportation – Present & Future” which is a very important subject for Pakistan, I would like to present some personal experience which needs attention of the engineers.

i. I have worked in Holland for some time. Whenever I went out along a road, I found a 4’ wide cycle track running parallel to the main road. All the slow moving traffic & cyclists use this small track and the main road is free for use of the fast moving traffic. The system is working very comfortably.

ii. During the last August, September and October, 2015, I was in England. One day I was having a walk along the foot path of a main road. At one point, I wanted to cross the road and move to the other side. I put my right foot on the

road and saw a fast moving car along the sloping road. I pulled back my foot, but the car driver stopped his car and told me, “You move first.” He moved after I had gone to the other side. The pedestrians have the first right on the roads.

Reaching a roundabout or a crossing of roads, the vehicle coming from the right has the first right. You have to stop at such points till the vehicle coming from the right has passed. Such a culture once it is developed creates a lot of comfort and safety. Side by side with the development of means of transport, we must establish means of traffic safety. Both are essential parts of transportation system and both deserve special attention of the engineers and road users.

I do not wish to stand between you and the luminaries who will be assessing the conditions of transportation of the Country in world-view for improvement and expansion. I would be keenly awaiting the recommendations formulated by the panel of experts.

Pakistan Zindabad

The 73rd Annual Session
of
Pakistan Engineering Congress

"Annual Symposium"



Chief Guest Engr. Barkat Ali Luna on arrival at the Congress Headquarter



Chief Guest Engr. Barkat Ali Luna being received by Engr. Ch. Ghulam Hussain, President elect of 74th Session. Also seen on the left is Engr. Dr. Izhar ul Haq, Vice President (PEC)



(From left) Engr. Dr. Izhar-ul-Haq, Engr. Ch. Ghulam Hussain, President elect of 74th Session, Engr. Barkat Ali Luna, Chief Guest. Engr. Syed Mansoob Ali Zaidi, Secretary PEC can also be seen in the picture.



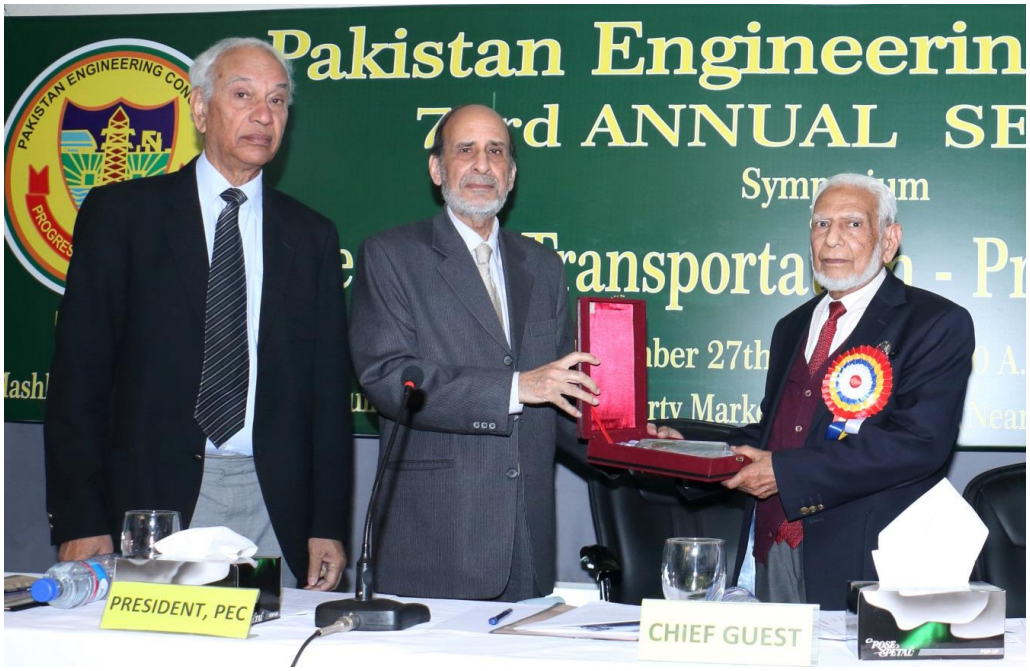
Engr. Ch. Ghulam Hussain, Vice President (PEC) / President elect of 74th Session Speaking at the event.



Engr. Dr. Izhar ul Haq, Vice-President (PEC) presenting Key Note Address at the Annual Symposium. Also seen from the left, Engr. Barkat Ali Luna, Chief Guest, and Engr. Syed Mansoob Ali Zaidi, Secretary PEC



Chief Guest Engr. Barkat Ali Luna presenting his address at the Annual Symposium held on the topic of “Means of Transportation – Present & Future”



(From Left) Engr. Dr. Izhar ul Haq, Vice-President and Engr. Ch. Ghulam Hussain, President elect, (74th Session) presenting shield to the Chief Guest Engr. Barkat Ali Luna



(From Right) Engr. Ch. Ghulam Hussain, President elect of the Congress (74th Session) being interviewed by the media.



(From left) Prof. Dr. Tanvir Iqbal Qayyum, receiving shield from Engr. Ch. Ghulam Hussain, President elect - PEC 74th Session for presenting his paper on the topic of "*Concept of Sustainable Truck Ports and Determination of their Locations in Lahore"*



(From left) Dr. Umar Farooq, receiving shield from Engr. Ch. Ghulam Hussain, President elect 74th Session, for presenting his paper on the topic of "*Opportunities and Potential for the Ports and Shipping Sector & Multi-Model Transport of* Pakistan*"*. Also seen in the picture is Dr. Izhar-ul-Haq and Engr. Muhammad Amin.



(From left) Engr. Abdul Basit Sheikh, receiving shield from Engr. Ch. Ghulam Hussain, President elect 74th Session for presenting his paper on the topic of "*Use of Transport Models for Mass Transit Studies"*



(From left) Engr. Abdul Aziz Ch.,receiving shield from Engr. Ch. Ghulam Hussain, President elect 74th Session for presenting his paper on the topic of "*History of Railways in Sub-Continent and Rail Transport in Pakistan".* Also seen in the picture is Engr. Dr. Izhar ul Haq and Engr. S.M.A.Zaidi.



(From Left) Engr. Ch. Ghulam *Hussain*, President elect 74th Session presenting shield to Engr. Muhammad Amin, V.P-PEC for chairing the Technical Session

Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience





Glimpses of the Audience





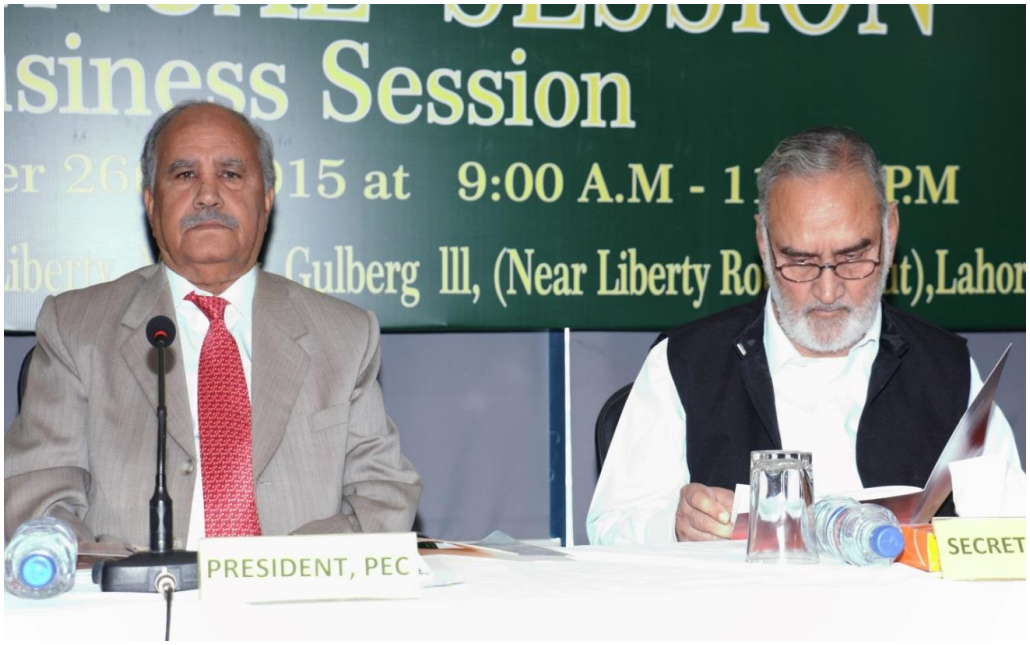
The 73rd Annual Session of
Pakistan Engineering Congress
"Business Session"



(From left) Engr. R. K. Anver, Vice-President (PEC), Engr. Riaz Ahmad Khan, Past President (PEC) and Engr. S.M.A. Zaidi, Secretary (PEC)



Engr. Syed Mansoob Ali Zaidi, Secretary (PEC) presenting the Secretary's Report of 73rd Session (January 2014 to December 2015)



(From left)), Engr. Riaz Ahmad Khan, Past President (PEC) and Engr. S.M.A. Zaidi, Secretary (PEC)



Members of the Executive Council of Pakistan Engineering Congress offering prayers for the departed souls

1st row (From Right) Engr. Husnain Ahmad, Engr. Ch. Muhammad Arif, Engr. R.K.Anver, Engr. Dr. Izhar-ul-Haq, Engr. Ch. Ghulam Hussain, Engr. Ijaz Ahmad Cheema.

2nd row (From Right) Engr. Tariq Rashid Wattoo, Engr. Capt. (R) M. Qadir Khan



Engr. Husnain Ahmad, Vice President / Past President PEC speaking on resolutions presented at the Business Session.



Engr. Ch. Ghulam Husain, President elect 74th Session of Pakistan Engineering Congress expressing gratitude for his un-opposed election and his commitment to come-up to the expectation of the members of the Congress



(From left)) Engr. Husnain Ahmad, Vice President / Past President, Chairman of Business Session, Engr. Riaz Ahmad Khan, Past President (PEC) and Engr. S.M.A. Zaidi, Secretary (PEC)

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Detailed Recommendations Offered

by the Speakers

at the

Annual Symposium

held on the Topic of

Means of Transportation

Present & Future

Engr. Abdul Basit Sheikh

To plan the city properly following recommendations are made based on a study:

- Comprehensive Transport Models for private and public transport users shall be built for all big cities.
- Legally bound Transport Master Plans based on Traffic Model results shall be implemented.
- Traffic Models shall be validated and updated each year.
- Socio-economic data shall be with Transport Planning Authority.
- At least on city level one type of traffic Model Software shall be used.
- Mass transit solutions are the only solution left with the city planners to control congestion and to move people.

Engr. Muhammad Jabbar

- The concept of Inland Navigation System as a mode of transport in Pakistan through river Indus, its rivers and canals has been discussed for the last two decades. Various Government and Semi-Government agencies have carried-out desk studies on the prospects of Inland Water Transport System in Pakistan. For one reason or the other this aspect of transportation could not be considered seriously and no practical steps have been taken so far to ascertain the viability or otherwise of the project.
- All previous comprehensive transportation studies in Pakistan have pointed-out the importance of developing an inland water transportation system in order to reduce the costs of freight transportation. Water transportation is the least expensive mode for moving freight. It is particularly used in other countries to move bulky and heavy commodities, such as raw materials for industrial production and agricultural products. Water transportation is typically the best mode to handle freight that is not as time-sensitive and is moving between locations along or near a waterway.
- A pilot project of IWT from Nowshera to Daud Khel covering a distance of about 210 Km (130 Mile) be investigated. This section of the route is not likely to involve any major technical problem and implementation will be easy.

- Water transportation is also the most energy efficient mode to handle freight. It has been estimated that water transportation consumes only 8% of the energy required by highway transportation and about 25% that required by rail.

In a country like Pakistan, with significant population centers, a major agricultural producing region and manufacturing areas near major rivers and canal systems, an opportunity exists to develop a commercial navigation network. An inland water transportation system along the Indus river, its tributaries and canals can not only reduce transportation costs to improve the competitiveness of existing products, but can also help the Government of Pakistan promote the area to attract additional development, in accordance with an overall long-term development strategy.

Engr. Abdul Aziz Ch.

1. Train Operations:

Decision taken by the Federal Cabinet in its meeting held on 10th March, 2010, approved a summary submitted by the Cabinet Committee on Restructuring (CCOR) of Public Sector Enterprises (PSE's) which included PR as well.

2. National Transport Policy :

To give the true direction to the modes of transport national transport policy should be finalized to set-out aims and objectives for transport as a whole.

3. Legal Frame Work

Prepare legal frame work for active participation of private sector in the rail sector.

4. Fare Rationalization

Railways administration be empowered for maintaining the flexible system of tariffs and fares for passengers.

5. Investment

Pakistan Railways needs massive investments just to arrest the fast depletion of its rolling stocks and fixed infrastructure as well as their up-gradation.

6. Pakistan Railways:

Pakistan Railways should finalize and announce Public Private Partnership Policy for active participation of private sector in rail sectors. It should also introduce the Track Access Charges Mechanism to become a basis for private sector investment and partnership for freight & passenger operations of Pakistan Railways.

7. Commercialization of Assets

Pakistan Railways own very costly patches of real estate at prime locations in major cities of the country which have lot of potential for commercial exploitation. Joint ventures through private sector participation in real estate development on Pakistan Railways land will be a preferable solution.

Engr. Musharraf A. Khan and Prof. Dr. Tanvir Iqbal Qayyum

'Truckport' is a novel concept and is one stop facility where all freight handling activities are performed in a systematic, planned and efficient way, fulfilling the needs

of trucks and truck drivers, providing less or zero hindrance to city traffic and produces reasonable revenue to the Government in turn.

As a pilot project, Truckport should be established at or near GT Road - Ring Road crossing on Battapur side, for Indo-Pak trade. It should be linked by Railway line also.

Other Truckports locations recommended are:

(a) On or near Gujranwala Road - M-2 link crossing after Shahdra

(b) On or near Sheikhupura - Faisalabad Road M-2 crossing.

(c) On or near Multan Road - M-2 crossing

(d) On or near Ferozepur Road at Gajjumatta.

Muhammad Zia Ullah

MAIN RECOMMENDATIONS

1. Revive the original Railway Board with Railways Professional as its Chairman/Ex-Officio Secretary. (The system is working well on Indian Railways without any major restructuring since 1947)
2. Restore full autonomy to the Board.
3. Working of Planning Commission should be critically reviewed and completely overhauled. Their Veto powers must be withdrawn and there should be accountability for abnormal delays in processing the PC1s.
4. Professionally competent retired Pakistan Railways Officers can be co-opted for their valuable contribution based on their vast experience whenever needed. As these officers won't have anything at stake, they will be free to give their input without fear or favour of the Bigwigs.
5. The General Manager should be the CEO of the Railways for implementing the policies laid down by the Board and running the railways.
6. The Pakistan Railway's Officer Cadre is in need of savage down sizing owing to its heavily bloated nature. There is a galore of BS-21 Officers with hardly anything to do. The result is that each is busy jockeying into a position of greater authority. The Officers Cadre be trimmed to 1978-79 levels when the Pakistan Railways was carrying five times more Freight Traffic and three times the current Passenger Traffic. A lean mean and keen cadre will result in savings of Millions with improved productivity as a bonus.
7. A proper Research and Development Directorate should be set-up with competent and willing officers to man it. It should not be made a dumping ground for unwanted officers. This department should then be tasked with working out essentially needed improvements in the Pakistan Railways – Short term plus long Term. The Planning Directorate in the Ministry of Railways should then work in close collaboration with this Directorate.
8. The Freight Wagon two axle fleet of 1920 vintage needs to be done away with on a regular annual basis. The top of the line locomotives hauling these vintage wagons is akin to a Merc Prime mover hauling a tractor trolley. India went in for Central Buffer Couplers (CBC) way back in the mid 1990s. These CBCs have enabled Indian Railways to now have trains of 5000 Gross tones hauled by

6000 HP Locomotives. We on the other hand are limited to 2250 Gross Tonnes because of the ancient hook and chain coupling. Pakistan Railways needs to make a beginning in this direction straight away. Forty of these wagons with air brakes can be accommodated in the loops of most stations on the main line. These should then be put to haul bulk traffic in Unit Block Trains for maximum productivity. These should be subjected to preventive maintenance and should run non-stop with double sets of crews resting on the new Brake Vans (Cabooses) equipped with sleeping facilities. The average speeds of these trains will then match the average speed of stopping Mail and Express trains.

9. The passenger trains similarly should be run with 25 to 27 coaches to become money-spinners. Shatabdis on the IR now run with 27 coaches mostly. For this plans should be made in advance to lengthen the platforms instead of waking-up when the Media shows people rolling on the track ballast!!

10. Substantial additional allocations be made to Railways for improving the condition of its assets and replacing overage assets e.g. Locomotives, signalling wagons, coaches etc.

11. Substantial additional allocations be made to Railways for improving the condition of assets and replacing overage assets e.g. Locomotives, signalling etc.

12. Introduce Electric Traction, in phases, on top priority to drastically cut down maintenance costs and reliability of Locomotives.

OTHER RECOMMENDATIONS

13. Ensure judicial investment in different sectors for achieving maximum overall efficiency of the system with minimum investment.

14. Put a hold on expensive double track projects till these are analyzed realistically in detail. Double track projects completed earlier be evaluated to see if the benefits and IRR envisaged in PC-1 have been achieved. This will show the way forward. The fund saved may be re-appropriated to fund other essentially required projects like Signaling, Locomotive Rehabilitation and High speed High Capacity Freight wagons.

15. Exploit vast real state, especially in major cities, through joint ventures/ private partnership.

16. Pakistan Railways is the owner of thousand of tones of high grade steel scrap in the form of abandoned railway lines and wagon and coach axles and old steam locomotives. Hundreds of kilometers of track abandoned long ago on closed lines is rotting or is being gradually stolen away by the Re-rolling Mills mafia. With the Steel Mills almost at a stand still it is a golden opportunity for the Pakistan Railways to start its own Steel Re-rolling Mill or auction this golden junk on an as is where is basis in a transparent manner. This should bring in Billions for the cash strapped Pakistan Railways for buying much needed Freight Cars and Coaches.

17. A realistic Transport Policy by the government should ensure that Railways have the “first right of refusal” for all government traffic.

18. PSO (Public Sector Obligation) must be provided in the beginning of financial year rather than picking it up at the end of financial year in the shape of “Loss.”

19. Concentrate on intercity fast trains leaving short distance traffic to roads.

20. No new loss making train should be introduced unless PSO is agreed and paid in advance.

21. Revive Railways Account service.

22. Standardize Locomotives (and other major equipment e.g. power van generating sets, track machines etc.) PIA has standardized 2-types of planes i.e. Boeing and Airbus. Railways should also standardize 2 makes of well known internationally renowned diesel engines.

23. Replace obsolete 2-axle slow speed high maintenance freight wagons with fast high-speed high capacity wagons. This will have a great economic impact as:

i- Locomotives requirement will be reduced.

ii- Sectional capacity will be released saving expenditure on other capital-intensive measure e.g. doubling of track, modern signaling etc.

iii- Reduced transit time with improved reliability will induce confidence in rail traffic.

iv- Operating and maintenance costs of the wagons will reduce sharply.

Dr. Shafeeq Ahmed and Dr. Shahab Khanzada

Recommendation:

1. With a mean observed tire pressure of 896 kPa, the Design RDF for the legal axle load (118 kN) and the mean observed axle load (145 kN) on single axle with dual tires was found to be 5.80 and 11.95, respectively.

2. The damage factors derived in this study can be readily used for network level pavement management.

3. The damaging effect of loads and further relaxation on permissible legal load limits needs no further emphasis. Our road pavements are being punished to phenomenal limits which defy all standard design procedures. The trucking industry is further pushing NHA for relaxations in the axle loading limits. This will escalate our maintenance needs for which resources are stretched to the limits.

4. The flexible pavement performance against distresses such as fatigue cracking and rutting is significantly affected by the stiffness of unbound base course and subgrade.

5. Gradual replacement of ailing trucking fleet should be encouraged through import of multi-axle turbo-diesel trucks on subsidized rates.

Muhammad Ziyad Rasheed, Ahmad Sallar, Naveeda Ahmad, Mariam Masood, Mubasher Nawaz, and Ahmed Hassan

1. CONCLUSION AND RECOMMENDATIONS

1. It is highly recommended that the proposed system may be employed by the Pakistan Railways.
2. PR needs to employ modern GIS techniques in order to maintain its land records, maintenance schedules and railway asset details.
3. The rail timetable scheduling should be done using modern software in order to ensure robust timetabling. One such technique has been shown in this paper.
4. There is a huge potential for modern research on this topic. Modern researchers need to target the areas of railways scheduling and delay minimization.
5. There is no academia and industrial linkage for Railways in Pakistan. The future researchers and industry experts need to create a forum where the issues pertaining to rail operations are discussed.
6. It is expected that higher cooperation will be provided by Pakistan Railways and Pakistani Universities in this regard.

Engr. Maryam Nawaz and Prof. Dr. Tanvir Iqbal Qayyum

RECOMMENDATIONS FOR SUCCESSFUL IMPLEMENTATION

The system is proposed by keeping in view the ease in its implementation. It merely relies on the police willingness and readiness to adopt the system. However, there are some valuable recommendations for the proper and successful implementation of the system: (i) it is strongly recommended to complete all the legal and administrative formalities (paper / documentation work) before the implementation of the system. (ii) to constitute a Working Group comprising of the members from all concerned stakeholders and represented by the lead agency (i.e. CTPL). (iii) there is a need to revise traffic laws and policies to define the criteria for reportable and non-reportable crashes. It is required for minimizing the under-reporting.(iv) to develops SOPs for linkage with other key stakeholders in order to obtain and corroboration of relevant information from them. (v) publication of manual on data variables. (vi) personnel training.

Review of local and international practices proved as valuable tool to propose an improved crash data collection mechanism for CTPL. This study has tried to propose such mechanism which is easy to implement and provide accurate, uniform and comprehensive information to all concerned stakeholders and ultimately, it will remain helpful in developing efficient road safety policies for a region.

Current command and control structure of the traffic police of the Punjab has two components: (i) Punjab Traffic Warden Service which exists in the five big cities of the province including Lahore and (ii) Traffic Police Punjab which is present in the remaining parts of the province. However, there is only difference of administrative hierarchy but the overall system is the same so, the proposed mechanism can be expanded province wide after its successful implementation in Lahore. Later on, it can be expanded at national level to develop centralized database/bank which will facilitate in developing efficient national road safety policies.

SOLAR TARIFF CUT BY 27 PERCENT FOR NEW PLANTS

ISLAMABAD: The National Electric Power Regulatory Authority (Nepra) on Wednesday cut upfront tariff for new solar power plants by more than 27 per cent, mainly due to declining solar photovoltaic (PV) prices in the global market.

Under the new regime, the regulator set two different upfront rates for solar plants in the country's South and North regions with generation capacity ranging between 1 and 100MW.

It said the new tariff would be 11.35 cents to 11.53 cents per kWh for North region and 10.72 to 10.89 per kWh for South region.

Through the new rates, an attempt has been made "not only to create a balance between the interest of the consumers and the investors but also to encourage investment at the same time".

The first upfront tariff for solar PV power plants was determined in January 2014 for a total capacity of 50MW with project size of 1 to 10MW. At that time the regulator had determined levelised rates of 16.30 cents per kWh for South and 17 cents per kWh for North with a validity period of six months. The said tariff expired on July 20, 2014.

After the expiry of the first tariff, proceedings were initiated for development of second upfront tariff for solar PV power plants.

On Jan 22, 2015, the regulator revised the rates under the second upfront tariff without limiting to any capacity induction for project size of 1 to 100MW, levelised rate was set in the range of 14.15 cents per kWh to 15.02 cents for three sizes of the projects i.e. 1-20MW, 20-50MW and 50-100MW for South and North. This will expire on Dec 31, 2015. Mega projects like 900MW Quaid-i-Azam Solar Park would be based on that tariff.

The fresh rates announced on Wednesday would remain applicable until end-June 2016.

The new regime has built-in degradation impact in tariff, revised capacity utilisation factor and the sharing mechanism on generation of excess energy.

In the previous upfront solar tariffs annual degradation of 0.7pc from year two to 25 was allowed. Now better quality solar modules with 0.5pc annual degradation are available in the market but the cost is relatively higher. This extra cost not only caters for lower degradation but also ensures better power output over the life of the project.

Therefore, the regulator approved 0.5pc annual degradation from year two to 25. In order to increase the number of modules, other equipment e.g. mounting structure, cables, civil works will also be required, therefore, application of degradation only to module price is not justified, the regulator said, adding that it accordingly decided to apply 3.62pc levelised degradation to Engineering Procurement and construction (EPC) cost.

The system capacity utilisation factor (CUF) is also a key driver to the solar project's economics. A good quality solar PV system will be capable of achieving higher CUF. In its previous upfront rates, the Nepra had used CUF of 17.5pc for South region and 16.78pc for North region and the PV rate was based on these capacity utilisation factors.

It has now decided to enhance the CUF to 18pc for South region and 17pc for North region for calculation of the upfront tariff.

Also, in the previous rates, excess energy beyond the benchmark capacity factors was shared between the power producer and the purchaser in the ratio of 75:25 for first one per cent and then 80:20 for the second one per cent. This rate has now been revised to 80:20 and 90:10. This step is expected to promote investment in better technologies.

Nepra said the new upfront rate was aimed to provide certainty to the investors willing to install solar plants in the form of certain tariff structure, returns and short processing time. The choice to opt for upfront tariff will be applicable from January 1, 2016 and will remain valid for a period of six months.

TARBELA-4 EXTENSION TO BE COMPLETED BY JUNE 2017

Water and Power Development Authority (Wapda) Chairman Zafar Mehmood has said that the Tarbela fourth extension hydropower project would be completed in June 2017, enabling the country to add 1,410 megawatts (MW) to the national grid.

The Tarbela Dam was built in 1974, boasting 3,478 MW generation capacity. The decision to complete the Tarbela-4 extension would take the capacity to 4,888MW with plans to construct the fifth extension also in the pipeline. Construction work on the latest extension is scheduled to start in March 2016 with World Bank confirming to finance the project.

While briefing a group of journalists at Tarbela Dam, Mehmood said the fourth extension would be completed a year before its original deadline and an additional sum of $51 million would be paid to the contractor to ensure it happens.

“The original completion date of three units of the Tarbela-4th extension hydropower project was scheduled in February 2018, but by completing it in June 2017, energy valuing $300 million will be generated during this year,” he said, adding that the Dam had five tunnels but power houses were installed at three of them.

Under the fourth extension project, a power house would be set up at tunnel four whereas work on the fifth extension hydropower project would be started soon. “Over 40% of the civil work on the fourth extension project has been completed, while the electrical and mechanical work is on target.”

He said the World Bank had floated the idea of converting tunnel five into power generation in 2011.

The current tunnel function is to release irrigation water before reservoir is raised to spillways level.

Mehmood said the World Bank was financing $2.5 million for the study and the project is scheduled to be completed in 39 months.

He said the Tarbela Dam was built to store water for irrigation purpose and electricity was a by-product. Hence, Wapda is bound to follow orders of water regulator, the Indus River System Authority (Irsa), to release water that would meet irrigation demand of provinces.

“However, we have an evaluation study that Tarbela-4 and 5 extension hydropower projects were feasible,” he said, adding that the life of Tarbela Dam was 50 years. He also disclosed that World Bank had financed Tarbela Dam and its last instalment of loan was paid in 2014.

He also stated that there was a plan to replace the existing turbines of Tarbela Dam. “At present, there is modern technology available in the market which is more efficient,” he said. “Replacing existing turbines would result in enhancing generation capacity from 3,478 MW to 4,000 MW.”

However, he cautioned that this plan would require huge investments.

CHINA APPROVES LOAN FOR THAR COAL MINING, POWER PLANT

ISLAMABAD: China formally approved on Wednesday $1.2 billion investment for mining of 3.8 million tons per annum (MTPA) of coal and the setting up of a 660MW coal-fired power plant in Tharparkar and invited Pakistan to sign the lending agreement early next week.

The final lending documents will be signed on Dec 21 in Beijing, according to an announcement by the ministry of water and power.

It said the China Export and Credit Insurance Corporation — commonly known as Sinosure — had written to the ministry that the coal-fired power plants and surface mining in block II of Thar coal field had been approved by the State Council of China, and was now waiting for both sides to conclude the loan agreement and insurance policy.

It is expected that agreements of loans required for the project — around $800 million from a Chinese banking syndicate, led by the China Development Bank and the Industrial and Commercial Bank of China, and about $500m from a Pakistani banking syndicate comprising Habib, United and Alfalah banks — will be signed in Beijing on Dec 21.

An official said financing by local banks had been arranged at Karachi Interbank Offered Rate plus 1.7 per cent and Chinese lending at London Interbank Offered Rate plus 3.3 per cent.

Sinosure has asked Islamabad to ensure that sovereign guarantee for the mining sector was issued by Dec 25. An official said arrangements had been made to ensure it as formal approval had been obtained.

Arrangement of finances and completion of lending documents are the most critical parts in any project, signifying starting point of actual work on the project.

Sinosure and the Sindh Engro Coal Mining Company (SECMC) are jointly undertaking surface mining of 3.8 MTPA of coal and establishment of a 660MW power plant in Tharparkar under the umbrella of $46bn China-Pakistan Economic Corridor (CPEC).

This is the largest project on the top priority list (early harvest programme) of the CPEC agenda and the first to have reached such an advanced stage after the signing of CPEC energy project agreements in November last year. The accords envisage 14 projects of 10,400MW in the first phase, which are targeted for commercial operation by 2017-18.

The two governments initially focused on the Thar coal mining and power project and completed regulatory approvals between Nov 2014 and March 31, 2015. The arrangements included a power generation policy approval by the Council of Common Interests, followed by standard security package, including approval of implementation and power purchase agreements.

To facilitate the project, a supplemental agreement particularly designed for Chinese investment under the CPEC was approved by the Economic Coordination Committee of the cabinet that entailed creation of a revolving account to provide for a minimum of 22 per cent of monthly power purchases and a sovereign guarantee recently issued by the federal government.

Total cost of the coal mine upgradation to 3.8 MTPA has been estimated at about $900m and that of the 660MW power plant at $1bn. Of the two amounts, around $1.2bn will come from China.

About $500m equity is being arranged by the SECMC — a joint venture of the Sindh government and five private firms led by the Engro Corporation. Another $200m will be arranged by Chinese contractors.

Pakistan and China have already entered into an agreement for laying a transmission line for evacuation of electricity from the Thar plant to the national grid near Matiari and then onwards up to Lahore.

This will ensure that the first power project begins commercial operation by Dec 2017 at levelised tariff or 9.5 cents per unit.

MANGROVES TO THE RESCUE

The Indus Delta once used to be home to thick mangrove forests stretching from Karachi to the Rann of Kutch. Today, only some pockets of these forests remain. Before the deterioration of the mangroves began, Pakistan was one of the largest mangrove countries in the world; these forests provided rich breeding grounds for fish, crabs and shrimps, in addition to protecting the coast from storms and tsunamis. Over the passage of time, the mangrove forests came under extreme pressure due to continuous seawater intrusion, lack of fresh water being released into the delta, pollution, cutting of wood for fuel and timber and grazing by camels.

The Indus Delta consists of several creeks, including those located at the Keti Bunder Union Council of Thatta District. This area once used to contain one of the largest tracts of arid zone mangrove forests. Keti Bunder town itself was once a prosperous place where the local people used to grow red rice and bananas; now their agricultural land has been swept away by the intruding sea or spoilt by water-logging and salinity. Eight species of mangroves used to grow in the area. Only three species have survived: Avicennia marina, Aegiceras corniculata and Rhizophora mucronata. There has been a gradual decrease in fresh water in the delta since hardly any river water is released below the Kotri Barrage and an increase in saline water has seriously constrained mangrove growth.

The erosion of the mud flats in the creeks (now full of seawater), has led to considerable migration of the local fishermen from the delta area to places inland and even further to Karachi's coastal fishing villages like Ibrahim Hyderi. The World Wildlife Fund-Pakistan, which has been working in the Indus Delta for more than a decade, believes that the planting of mangroves can minimise land erosion and protect the coast from cyclones and storm surges, which will get worse with climate change. It has been supporting the local communities to plant mangroves, particularly in Hajamro creek, which is home to one of the last settlements at the mouth of the Indus Delta facing the Arabian Sea.

This area is most vulnerable to direct, strong waves from the sea and intense winds as well. Experts say that wave energy may be reduced by 75 per cent during a wave's passage through 200 metres of mangrove forest. WWF-Pakistan has raised awareness about the importance of mangroves. Around 7,500 hectares of mangroves were planted by WWF-Pakistan earlier with the help of local communities and more recently another 525 hectares were planted through its "Building Capacity on Climate Change in Coastal Areas of Pakistan" project. Avicennia Marina, a local species that requires less freshwater, was mostly planted since it is more salt tolerant.

The good news from the Indus Delta is that WWF-Pakistan's efforts have paid off. In December 2012, a delta-wide hazard mapping study was conducted in the area. This study covered the land cover/land use changes (forest changes, land erosion, etc.) through using satellite images and geospatial technology provided by the GIS lab at WWF-Pakistan. The results reveal a significant increase in the forest area of all the three project sites, i.e, Keti Bunder, Kharo Chan and Jiwani, where WWF-Pakistan is working. In Keti Bunder, the increase in the forest cover clearly seems to be the result of plantation activities thereby proving that Pakistan's coastal areas can adapt to climate change if proper action is taken on the ground.

KALABAGH DAM THE ONLY SOLUTION TO WATER, ENERGY CRISIS

LAHORE: The All Pakistan Business Forum (APBF) President Ibrahim Qureshi has urged the government to declare a water emergency, keeping in view of water storage in the country, adding due to that lack of appropriate steps to maintain the storage capacity, the country would face severe water crises within 10 years.

The APBF president said that the Indus River System Authority (IRSA) has constantly warning the government on water scarcity and urged that all the allocations of the Public Sector Development Programme (PSDP) should be spent only on enhancing water storage capacity. He said that Pakistan has to develop mega and small dams to store water to avert the upcoming water crisis. He added that the shortage of water has not only caused undue damage to the agriculture sector but also the manufacturing sector.

He said, "We cannot waste more time and the government should pave a way for early construction of the Kalabagh Dam (KBD), which is the only solution to the water and electricity shortage." He emphasised that Pakistan's economy is based on the agriculture sector and could not survive without sufficient water resources.

Ibrahim Qureshi said that KBD was the most suitable project for the national economy as it would not only produce cheap and sufficient electricity but would also avert the devastation caused by the floods. The KBD is a must to control the poverty and those who opposed its construction are playing with the country's future, he added.

It is unfortunate that Pakistan has no water policy for the last 16 years, which could define the roles of different stakeholders including the federation and the provinces.

He said that with a 14%water shortage estimated for the Rabi season, the IRSA has asked the government to move towards building dams on urgent basis to avoid the loss of billions of rupees every year.

He said that wastage of one million acres feet (MAF) of water was estimated to cause an economic loss of Rs 60 billion as about 36 MAF water had gone into the sea last season, including 8.6 MAF, which was required to flow below the Kotri barrage for environmental reasons. This meant that over 27 MAF water had been wasted in just one season that was equivalent to the storage capacity of three big dams, he said.

Qureshi said that IRSA had been asking the government to take decisive initiatives towards building new dams and had written to the government to divert all development funds towards building new dams as a national emergency but the government is not serious in this regard.

He advised that the government should move swiftly to build Kalabagh and Bhasha Dams simultaneously and construct Munda Dam for long-term protection for the lives and properties in KPK's Nowshera region. He said that these dams should have been built in the 80s and 90s but Pakistan failed to building even one of these over the last 3 decades.

UNCERTAIN CLIME

ON Dec 12, world leaders reached a climate change accord in Paris. The agreement has been widely hailed as historic and world-changing by most world leaders. Jeffrey Sachs, head of the Earth Institute at Columbia University, called it a diplomatic triumph.

Undoubtedly, the climate agreement is historic in as much as its unprecedented consensual nature is concerned. In an age of growing international discord, the agreement represents the triumph of the United Nations Framework Convention on Climate Change process. The agreement is also significant when seen in the backdrop of the last climate conference in Copen-hagen which concluded without any agreement.

Moreover, it is historic because it puts the issue of the gradual phase-out of fossil fuels on the agenda alongside scaling up the ambition of limiting the rise in world temperature to an ideal 1.5 degrees Celsius though keeping the increase to below 2°C as officially achievable.

The agreement incorporates a regular five-yearly review of carbon emission targets pledged by individual countries, and is also legally binding in the broadest sense of the term. In fact, there is a lot in the agreement to be upbeat about in the long term. And there is something for everybody to celebrate.

Yet in the drive to reach the broadest consensus, specific goals and targets have been done away with or watered down. Elizabeth Korbert, an influential writer on climate change, has called the agreement a triumph of comity over coherence.

On the surface, the agreement is broadly legal binding, though the devil of non-enforcement is in the detail. This is the agreement's Achilles heel which has swelled the army of detractors after the initial euphoria. These doubts centre on a number of areas.

First, limiting warming to less than 2°C seems well beyond the wildest possibility. Even the preamble of the agreement acknowledges that the target will be hard to meet. The realisation of this target is further muddied when individual country targets submitted by 187 states are examined. The targets do not add up to realisation of the goal of achieving the 2°C target.

Secondly, there is no enforcement mechanism proposed in the agreement to make the gold of the agreement shine as put aptly by one blogger. Even modest targets proposed by individual nations are not enforceable. The targets set are entirely voluntary and depend on the political will of the countries involved. There is no firm commitment from the big polluters that they will reduce carbon emissions and there is no mechanism to sanction high polluters.

The United States fought hard to keep the deal sanction-free based on the argument that it would be easier to sell it to the climate-sceptic Republican Congress. Looked at this way, the deal is a big climbdown from the Kyoto Protocol which was more target-oriented and laced with some semblance of enforcement.

The issue of carbon pricing is also off the table in the new agreement. There is an indication of a five-yearly review of the carbon emission target which is going to start in 2023. In between, business as usual on climate change is likely to prevail.

Third, the Paris climate deal offers no guaranteed way forward on the festering

issue of climate financing despite the developing countries' overwhelming focus on it. The projected climate finance of $100 billion is entirely voluntary and aspirational. There is no firm and cast-iron commitment to contribute to the funding. The associated concern is that climate finance may be funded out of the money diverted from the already shrinking aid bud-get of the developed countries.

Four , there is a growing concern that carbon trading and re--newable energy will benefit business and industry, with the poor being left high and dry. In a neo-liberal age, with the declining power of the state over business regulation, it is hard to see how governments can force business into a direction which is not profit-oriented.

The world faces a climate emergency of unprecedented proportions. Yet, despite the hopeful and consensual wording of the document, action on agreement is hard to foresee. This is of a piece with previous attempts by the world's leading powers to delay the implementation of agreements.

The Paris agreement may have achieved consensus on a range of contentious issues. But the test of the deal would lie in the grinding work of monitoring and holding governments to account for the targets submitted by them and living up to the aspirational words embodied in the agreement. Now, as always, it falls to local and global civil society to prepare itself to hold governments to account and shout out louder for climate justice and equity.

WELL COME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering Congress 73rd Session approved Membership of the following new members into Congress fold in 73rd 9th Meeting of Executive Council held on 14-11-2015.

The Engineering News congratulates all of them and welcomes them to Pakistan Engineering Congress

Sr. #	Name	Sr. #	Name
1	Engr. Warda Eijazz	36	Engr. Saeed Ahmad Kherani
2	Engr. Waqas Sharif	37	Engr. Hafiz Muhammad Sohaib
3	Engr. Haseeb Ahmad	38	Engr. Muhammad Salman Shabbir
4	Engr. Muhammad Moazzam ul Ibad	39	Engr. Kanwar Naveed ur Rehman
5	Engr. Muhammad Tanveer Ashraf	40	Engr. Shahid ur Rahman
6	Engr. Muhammad Shehbaz Dogar	41	Engr. Javeed Akhtar
7	Engr. Muhammad Abubakar	42	Engr. Zain ul Abdin
8	Engr. Malik Muhammad Arslan Aslam	43	Engr. Kamran Afzal
9	Engr. Abdul Nisar	44	Engr. S.M. Irshad
10	Engr. Muhammad Rehan Saeed	45	Engr. Azhar Anwar Jafri
11	Engr. Muhammad Muneeb Sultan	46	Engr. Muhammad Siddique Qureshi
12	Engr. Farrukh Abbas	47	Engr. Dr. Muhammad Nawaz Bhutta
13	Engr. Zia ur Rehman	48	Engr. Col. (R) Syed Ghias ud Din
14	Engr. Muneeb Ali Mirza	49	Engr. Aftab Ahmad Soomro
15	Engr. Marium Shahid	50	Engr. Mumtaz Ali Memon
16	Engr. Tamseela Habib	51	Engr. Syed Muhammad Ahmad Fridi
17	Engr. Rashid Ahmed	52	Engr. Ch. Waseem Sajjad
18	Engr. Asad Amin	53	Engr. Imran Atta
19	Engr. Muhamamd Awais Saleem	54	Engr. Ameer Ali
20	Engr. Muhammad Javed		
21	Engr. Ali Imran		
22	Engr. Muhammad Imran Asghar		
23	Engr. Muhammad Rizwan Afzal		
24	Engr. Ali Zeb		
25	Engr. Farah Riaz		
26	Engr. Asif Ali		
27	Engr. Wajahat Iqbal Hussain		
28	Engr. Muhammad Haseeb ur Rehman		
29	Engr. Syed Muhammad Tayyab		
30	Engr. Sonia Ramzan		
31	Engr. Shamas Javeed		
32	Engr. Issa Bilal Malik		
33	Engr. Saif-ur-Rehman		
34	Engr. Syed Ali Aqdus Shah		
35	Engr. Farhaj Pervaiz		

Development of Malaysia's National Annex to Eurocode on Earthquake Resistance

The fruit of the labour to realise the completion of the Final version of the Malaysian National Annex to MS EN 1998 Part 1: Design of Structures for Earthquake Resistance is now in sight. The internal process of developing the National Annex spearheaded by the IEM Technical Committee (TC) on Earthquake has been progressing well with all major issues and comments being properly attended to ahead of public balloting at the end of 2015.

The progress could not have been achieved without the commitment and active participation of seismic experts from Australia, Canada, Hong Kong, Singapore and other countries. These experts volunteered their time and services without expecting any remuneration. They came forward in the spirit of sharing their knowledge, expertise and ideas that could strengthen international collaboration. More importantly, they shared a common concern to help mitigate the impact of earthquakes and how the practice of earthquake engineering and monitoring of seismic activities could help to save lives.

One of the international experts who has devoted his time and efforts gratis to our country is Prof. Nelson Lam, Associate Professor and Reader, Department of Infrastructure Engineering, The University of Melbourne, Australia. JURUTERA speaks to Prof. Lam to learn more about his involvement in the development of earthquake code for Malaysia and the National Annex to Eurocode 8 (EC 8) for the Design of Structures for Earthquake Resistance.

How did you get involved in the drafting of Malaysia's National Annex to EC8, considering you come from Australia?

Prof. Lam: Currently, I am a reader at The University of Melbourne. At the university, we have the Centre for Disaster Management and Public Safety (CDMPS), which focuses on conducting multi-disciplinary research and training on disaster management and public safety both nationally and internationally. Our work includes providing research and development input into managing natural disasters to countries all over the world. I am one of the key members of this centre and I have a strong earthquake engineering background. One of my core responsibilities at the university is to get involved in earthquake disaster mitigation and code development not only for Australia but also for other countries.

I have been researching into earthquake engineering in the last 26 years. I am also experienced in code development in Australia itself and have been appointed as member of the code drafting committee of Australia (known as Standards Australia), which is responsible for continuous development of earthquake loading standards for the country.

From the perspective of research, I also have a longterm understanding of earthquake conditions in this region, including Sumatra, Indonesia and around Peninsula Malaysia. Because of my background and expertise, I am well placed to be part of the IEM study group, formed about seven years ago. Ir. Adjunct Prof. M.C. Hee (the principal of M.C. Hee & Associates, Malaysia) approached me to get involved in providing advice and support on earthquake design code development for Malaysia. Over the years, we have been undertaking a lot of study and research work with a view of coming up with the National Annex. The drafting of this Annex is a result of

years of hard work and the involvement of many industry experts, and IEM TC on Earthquake Engineering , which is actually my host in this country. In the initial five years, we gradually formed the study group co-led by M.C. Hee himself before the formation of IEM TC (Technical Commitee).

We also gradually trained talented Malaysian engineers to assist in the earthquake code development exercise. This was how both M.C. Hee and I have been co-leading this group and moving it forward.

I am not directly engaged by the Malaysian government. Basically the development of the National Annex is not in the form of a consultant contract to do the work. It is actually a long-term collaborative work that forms part of my research agenda being an academic at The University of Melbourne. I provide service and advice not only to Malaysia but also South Korea, and I am also involved in seismic hazard study in Hong Kong and Sri Lanka. To a lesser extent, I also have a strong interest in the seismic conditions in Singapore. Overall, I have knowledge of seismic conditions in this region.

What are the key objectives and guiding principles in this code development activity? Why 2,475 and 475 years of return period?

Prof. Lam: The main objective of having this code development is to protect lives. It is about life and the safety of the public – the occupants of buildings. I must also emphasise that the code is to protect all buildings, not just key government facilities. Let me clarify that the return period of 475 years (of seismic wave transmission at bedrock level indicating occurrence of earthquakes) has been the tradition held for a long time but over the last 10 years, it has been recognised by the research community around the world that this return period is not really appropriate or is not long enough for certain countries which are not experiencing earthquakes frequently enough, for example Malaysia.

The same thing applies to other countries like the eastern part of North America – they have for long done away with the return period of 475 years and are now using 2,475 years as a benchmark. I must say that although the Eurocode originally specified 475 years, a lot of countries like the United Kingdom have decided to go for a higher return period. So following a lot of research (not just done by me but also) by the world community of research, Malaysia should be bench marking on 2,475 years. I must emphasise that the return period of 2,475 years does not mean that we will experience an earthquake in every 2,000 years – it seems to be a long time and this is actually quite misleading to a layperson. It is a figure for reference based on the prediction of ground motion intensity of any given position in the country. In fact the length of time should not be interpreted as we are having an earthquake over that long period of time. It is not. It is a figure that is recommended for use as reference for design of buildings. Of course, the longer the return period is, the higher the intensity. Referring to the benchmark for ground motion intensity is critical to emergency response to earthquakes. The return period requirements are actually more stringent than that for ordinary buildings. But then no matter what type of building it is, you always use 2,475 years as reference. Then there is also a factor called the Importance Factor according to the classes of buildings. Different building types have different design ground motion intensity – there is no one design intensity for all building types. For example, it is important that hospital buildings or buildings with emergency response functionality are designed to a return period of 2,475 years in terms of ensuring a satisfactory level of potential performance of buildings in an earthquake.

Considering that Malaysia is classiied as low to moderate seismicity region with lack of local earthquake data, where was the knowledge base developed originally?

Prof. Lam: The knowledge base is widely shared because knowledge nowadays is not owned by one country. Lots of research papers are published in peer reviewed international literature. Of course having worked in this field in the last 26 years, I am myself well informed on this topic. I also contributed to the international literature as well as being recognised for helping to develop the seismic code for Australia. Over the last 15 years, I have also invested a lot of time studying earthquakes affecting Malaysia from a long distance, for example, offshore of Sumatra including the Aceh earthquake of 2004. I have also published papers and conducted research on long distance earthquakes of mega magnitude exceeding ML8 on the Richter scale. I had the experience of studying and predicting ground motion generated by long distance earthquakes. This exercise of mine did not happen recently. My first publication on earthquakes in this region was way back in the early 2000, that is more than 10 years ago. Over the years, I have maintained my interest in this region. While a lot of research work has been carried out on earthquakes generated from Indonesia, we must however not overlook the risk of having earthquakes occurring locally. Local earthquakes affecting Malaysia are rarely reported in the local literature. But I have also worked on this local data in recent times when working on the National Annex. We have attended to both long distance earthquakes and risks of earthquakes from within Malaysia itself. It's a feature worth covering in the Malaysia National Annex because this is something that has not been well discussed in the academic literature.

Is the final version of the Malaysian National Annex to EC 8 ready for adoption as the code of practice for earthquake design in local structural engineering practices? Please elaborate on some intricacies and issues involved in determining the nationally accepted parameters and specify, if possible, the date for the oficial release of the EC8 National Annex.

Prof. Lam: Currently a lot of dialogues are going on because the IEM TC also has the mechanism to interface with design engineers from around different parts of Malaysia. I understand that there is also internal consultation with engineers and experts in this country about the National Annex draft. Professional people in different parts of Malaysia are giving us feedbacks and this is part of the whole process of finalising the draft. As discussed earlier, the 475 years return period provision is not sufficient. So that is why for the National Annex we have set design requirements to exceed this period. I must emphasize that it's not just the case for Malaysia. Many countries have already done that – increasing the return period. If we are developing a code for this country, we must draft the code properly according to the latest development around the world, including in the United States, Canada and United Kingdom. I feel that they are the major countries which, although are far away from Malaysia, represent the forefront of knowledge in the field of earthquake engineering. Even in Australia there has been a code review. Although they call it a 500-year return period, their design of gound motions is actually higher than this figure so as to protect lives. The 500-year terminology is retained only as a matter of convention.

Earthquake engineering is evolving and it is a complex form of engineering so that is why it is not always straight forward. Hence it is expected that various professionals raise queries and we have responded to these in great details. We are receptive to opinions expressed by all. And we have good documentations that allow us to attend

to all feedbacks seriously and clarify issues.

The return period is also a major issue raised by the professionals in Malaysia. Some Malaysian engineers feel that we do not need to go so high from 475 to 2,475 years. I have provided the explanations. If you refer to world literature, you will also find a lot of explanations on this issue.

Another issue raised in Malaysia is about costs. In fact we have also done a lot of studies about cost implications. We have to consider that there are certain types of buildings and there are also different seismic hazards depending on soil conditions where buildings are constructed. For certain soil conditions, the cost increase is minimal. The cost will be higher for conditions which are more onerous, such as softer soils. So that is why when it comes to cost analysis, there is no one figure that can fit all conditions. You cannot generalise how much it is. The costs vary. When there is some increase in cost on certain types of construction and on certain soil conditions, it shows that we need to pay more attention to the safety of certain buildings in those conditions. By and large, the general total increase in the cost of construction is actually insignificant. The cost increase is approximately 5 to 8% on stiff soil which is the typical and fairly common soil type in built-up areas. Soft soil is more hazardous and this has been observed worldwide from past earthquake events where buildings suffered a lot of damage and high casualty on soft soil conditions. The figures quoted are structural costs only, and not the total costs of the building. Therefore the difference in costs boils down to much less than 5%.

Overall, cost analysis indicates that there are certain types of buildings on certain types of soil conditions that can be more hazardous than others; so this indicates that it cannot be business as usual. We have to put extra effort in attending to it.

Another issue for Malaysia is that this country's code model is different from that of Singapore. The Singapore code only considers long distance earthquakes. For the Malaysian National Annex, we consider both short and long distance earthquakes. It has been expressed by experts in this area that local earthquakes occurring in Malaysia must not be ignored although the data has not been well expressed in the literature. These mainly record mega earthquakes happening elsewhere but if we want to protect lives, we must look at both local and long distance earthquakes. This is very important.

Now we have already received a lot of feedbacks and properly responded to all of them. And according to our timetable, this internal process will conclude by November or December 2015, after which the draft will go to the public ballot, as per the standard procedure for codification. This stage of public balloting will take place up to March 2016. The next stage is to submit the National Annex to the Department of Standards Malaysia (Standards Malaysia), which is the national regulatory body for standards and accreditation. This is the timetable of our study group. Our responsibility is to submit the final draft of the National Annex to Standards Malaysia. We hope that Standards Malaysia will handle it swiftly and launch the National Annex by the early part of next year. We have invested so much effort and time and so we would like to see it being used.

Our relationships with the government bodies such as the Public Works Department (PWD) involved in the development of the National Annex has been good. They are fairly receptive to our point of view. We also have all the other industry players in the IEM TC, including PAM (Pertubuhan Arkitek Malaysia), Master Builders and CIDB

(Construction Industry Development Board). It is a broadbased TC, and our code development is industry-driven.

Please elaborate on the efforts that have been taken so far to prepare the industry to apply the National Annex to EC8 in terms of training and development of human resources, development of new construction techniques to comply with the latest code of practice and other pertinent areas to ensure full compliance to the code.

Prof. Lam: The National Annex is a regulatory document but more importantly is the knowledge base of the engineers who are going to put it into use. Ultimately we rely on the skills and knowledge of engineers on the ground to use the code properly. This is why education and training is very important.

We have been conducting short courses and workshops to educate engineers as well as government officers. On average, we run short courses once a year to introduce basic knowledge on earthquake engineering because this country has no experience in dealing with earthquake hazards. We have also run courses specifically to introduce and release the contents of the National Annex. We would like the engineers to be prepared for it so that is why we provide the details during the short courses.

In previous years, we have also held symposiums. We invited international experts from Canada, Europe, Korea, Singapore, Hong Kong and other countries to speak at these symposia. They are experts at the forefront of codes development. They came from a long way to Malaysia to review the most suitable approach to seismic design for the country. This has been happening regularly in the last three to four years to make sure that our approach has the necessary check and balance. It is not only reviewed by international professionals but is also exposed to review by experts from major countries. The reason why we single out countries like Canada, Korea and Germany is because the conditions in these countries are similar to Malaysia in terms of seismicity. The approach to earthquake engineering for places like Japan and California are different from countries like Malaysia. The seismic condition in Malaysia is more aligned to countries like Australia and Korea which have earthquakes occurring infrequently. That is why we have close relationships with these countries. There is a lot of misconception that earthquake experts from high seismicity countries that are suffering from frequent earthquake events are the ones that Malaysia should invite, but it must be noted that conditions in those countries are not the same as those in Malaysia so this is not something that we can take up.

Our study group also plans to publish a handbook because the National Annex itself is a legal document which is brief and only prescribes what is required. We still need to have the detailed descriptions of the background – why the National Annex made some decisions, what are the intentions, what is the right way of applying those rules and what are the work examples. The handbook will have all these so that we can assist engineers in understanding and applying the code effectively. This handbook will be specific for use in Malaysia unlike textbook on the book shelves which do not really focus on Malaysian conditions. We also plan to educate young engineers who have just graduated from Malaysian universities. The National Annex and Eurocode are fairly new so we cannot automatically expect universities to provide adequate education and training on the use of the National Annex on their own. This is part of our long-term planning for training and development in the industry.

What are your recommendations for Malaysia to strengthen networking and co-

operation amongst all stakeholders, including the government sector and the industry players encompassing engineers, architects and other industry professionals, in adopting and enforcing the use of EC as MS EN standards?

Prof. Lam: As mentioned earlier, the IEM TC already has representations from PWD, CIDB, PAM and other government and professional bodies, so there is already a well set up network to accommodate professionals from the different corners of the country. All of them contribute to the consultation process. There are also the participation by universities, for example, Universiti Malaya and Universiti Teknologi Malaysia. The TC is balanced with professionals and academics.

In light of the recent earthquake that hit Ranau in Sabah, please give us an update of your assessment of earthquake risks in Sabah particularly, and the rest of Malaysia.

Prof. Lam: Earthquakes are expected in Sabah, which is considered as having a high level of seismicity than Sarawak and Peninsula Malaysia. Yes, the recent earthquake was expected. AM5.9 earthquake on the Richter scale could happen in places like Sabah, which is of higher seismic risk. But we cannot make the judgement that earthquakes of that nature would only occur in Sabah. It can also happen in other parts of Malaysia.

Ranau, where the recent Sabah earthquake occurred,was only about 50km away from the capital city Kota Kinabalu. We have explained to professionals around Sabah that although the epicentre was 50km away from the capital city of Kota Kinabalu, we cannot rule out the possibility that future earthquakes can be closer to builtup areas. There have also been concerns about how we specify ground motion intensity requirements for the different parts of Sabah because future earthquakes here can even be worse than that happened in Ranau.

What are your recommendations for Malaysia to monitor seismic activities and mitigate the impact of earthquakes? What should the priorities be for Malaysia?

Prof. Lam: I must say that the standard of structural and civil engineering in Malaysia is advanced. We are confident that the engineers here have the basic knowledge to properly apply our code for seismic design purposes provided that we also give them adequate training. We don't consider it to be anything that's substantially new in terms of approach and techniques. It's all about getting the engineers to analyse buildings for seismic loads in order that they are able to identify vulnerable structures in the future, and put more strength on certain parts of the building. That's really what we think the skill and know-how required. So it's not required for engineers to learn any new sets of skills that they don't already possess.

I always support making investment as a priority to maintain a good level of seismic monitoring in the country. When earthquakes occur, we should get a good recording of ground motion. The study on future seismic risks is also not enough if we only base our prediction on what has occurred in the recent past. That on its own is not enough. That is why our study has involved surveying earthquake recurrence behaviour from around the world in seismic environments similar to that of Malaysia.

By area, Malaysia is a small country. This is something I like to put across. Because of the small size, over a period of time, the amount of data that can possibly be collected is naturally very limited. This can be a major issue. Basing on Malaysian data alone is not a good approach to take. It is better to study data from around the world so that we will get sufficient data to help in coming out with effective mitigating

measures.

In Malaysia, Sabah has conducted such a study. The Ranau earthquake has spurred everything. It's more urgent now to come out with the National Annex. We must get the Annex to be out as soon as possible.

In Peninsula Malaysia, we must remember the earthquake of 4.2 magnitude that occurred in Bukit Tinggi, Pahang several years ago. It does not mean that future earthquakes will occur in the same spot. Given that we have limited data, this may just be the assumption here. But in future, Kuala Lumpur may also be susceptible. It is not that far from Bukit Tinggi. Earthquakes can happen in any part of the country. For argument sake, there could also be equal chance of similar local occurrence in the south of the Peninsula, close to Singapore. So the launch of the Malaysian earthquake code will have certain implications on Singapore.

(With Permission and)

(Courtesy of IEM)

(Jurutera)

(January, 2016)

College Add

Planning & Design Concept of Man-made/Artificial Beaches in Coastal Urban Areas

By

Engr. M. P. Aftab

Abstract

Beaches are considered an important component of recreational water activities in most countries. Beaches are created where ever possible. Information/data requirements generally include topography of available land, bathymetric levels of the sea bed, geological/seismic conditions, tidal waves,meteorology, etc. Planning and Design consideration encompass study of area on dry land as 'inactive area' of beach, area under water to be 'active area' of beach, slope from end of dry beach (shoreline) to end of wet beach (toe of beach), size of sand, thickness /depth of sand, headlands,etc, besides orientation of beaches to face tidal action for its stability, and subsequent inspection/monitoring, routine and emergency maintenance requirements including replenishment of sand losses due to wave and wind actions depending upon the location of the beaches.Numerical and Physical Modeling are required to study stability of beaches.

1. Introduction

There are several beaches given by the Mother Nature in various parts of the world along seashoreline or islands. Now trend is increasing to have more and more beaches near the urban developments for easy access. In this regard, lands are being reclaimed and/or existing shorelines are reshaped and dredged to increase water depths to facilitate swimming and add to boating pleasure or other water sports.Beaches are dynamic areas which are controlled by the natural conditions, such as waves, currents and winds. User's behavior depends in part on the physical nature of the beach itself. Most of urban beaches are largely anthropogenic features where-in natural features are only the loose sediments. Similarly the values attributed to beaches vary greatly but represent economic, cultural, historical and social attributes of both individuals and groups (Ref.1). The future of urban beaches is expected to depend upon national and international policy strategies, marketing, revitalization of urban water/seafronts and climate and technological change. Very little attention has been given to the potential for the innovative revitalization or development of urban beaches in contrast to the urban former industrial waterfronts/seafronts where there have been large scale redevelopments (Ref.2). Now, urban planners,engineers and coastal experts/modelers are engaged in in-depth studies on the urban beach development as a specialized subject in developed as well as developing countries.

2. Planning & Design Approach

There is no conventional approach or established practice for planning and design of beaches. Limited documented referencesare available such as Manual of Practices. It is an on-going research/ development process.

Following key elements are generally involved in the planning and design development of beaches:

- Topographical Survey / Bathymetric Survey/GIS Imageries from satellites
- Environmental Baseline

- Storm Water Run-offs/Floods
- Planning of Urban Areas/Land use Plans
- Grading Plans
- Geological Features
- Meteorology
- Seismology
- Modeling

3. Conceptual Plans

Following items are mostly considered in the planning and development of beaches:

- Site Selection
- Layout
- Profile
- Landscape (Trees,shrubs. grass, flower beds, sitting lawns, etc.)
- Hardscape(Prayer areas, showers, changing rooms, rest rooms, gazebos, kiosks, walkways, promenades, decorative lights, signage, benches, dust-bins, etc.)
- First Aid/Rescue Centre
- Utilities (water supply, sanitary wastewater, storm water, irrigation, electric power supply,area lighting,telecommunication, etc.)
- Parking
- Gate House/Security Office
- Miscellaneous

Salient Features of a Beach are described here below:

- **Water**: It is very important that the project area is free from any significant air / water pollution known under environmental assessment studies. Measures are to be taken to retain/improve its' baseline condition established under the environmental assessment studies and necessary actions are taken for pollution prevention/controland mitigation of pollutants/discharges entering into the water body at any time so as to avoid deterioration of the quality of water. No storm water run-off and wastewater discharge is allowed to enter into the beach area. Adequate systems for collection, treatment and safe disposal have to be planned, designed and included in the area development plans for implementation. Most of the countries including Pakistan have already established General Environmental Regulations and Rules for Implementation.

- **Sand Size**: Median Sand Diameter of D50=0.4mm i.e. coarse sand
- **Thickness of Sand**: 1000-2000 mm is general range of layer thicknesses of sand valid under the condition that the beaches are frequently monitored and that appropriate maintenance/remedial measures can be carried out in case local erosion is observed which may result in exposure of fine soil.
- **Average Slope of Sand Surface**: 2.5% & 2% in Active and In-Active Areas of the exposed beaches and, 3.5% to 2.5% or the more sheltered beaches respectively are the preferred ranges of slopes. These are average equilibrium slopes based on the empirical engineering rules.

Actual slopes would depend upon the bathometric survey and levels decided to be achieved by reclamation/dredging operations, if required. It is not possible to create a static equilibrium shoreline since wave conditions vary from day to day and season to season thus affecting the magnitude and direction of sediment transport. Horizontal fluctuations of the beach shoreline are inevitable, as a result of varying wave directions in time; especially at both ends of the beach such fluctuations can be considerable, particularly for long beaches. During some periods offshore transport will dominate onshore transport, while in other periods this will be reversed. Particularly during relatively severe wave conditions sediment transport tends to be offshore directed, while during relatively calm conditions, direction will reverse to onshore. In a similar way, also the direction of long-shore transport will reverse from time to time, depending on the direction of wave incidence. The direction of the long-shore transport depends on the direction of the waves relative to shore. In order to minimize erosion (and thus maintenance) caused by long-shore re-distribution of sand, the beach should be designed normal to the annual wave energy (under the so-called equilibrium orientation).If the beach is constructed under a different orientation, it will result in erosion at certain locations. Even if the beach is constructed under the equilibrium orientation, the beach orientation will fluctuate due to variations in the wave climate. (Ref. 3, 4)

In addition to fluctuations, some sand net annual lossshould be anticipated. Due to waves, wind and currents some sand can be transported away from the beaches under some conditions. Rivers or wadies may counteract to sand losses to some extent depending upon the suspended solids content in the incoming flows. If there are no rivers or wadies existing close to beaches, long term balance of the beaches will therefore, inevitably be negative.

These considerations on equilibrium shapes and beach fluctuations imply that considerable ‘breathing space’ for beaches need to be created, as far as possible, to allow inevitable beach dynamics.

- **Miscellaneous**

(i) Depth of Water for Swimming Area: It may be restricted toabout 1.4m (slightly less than average man height preferably up to neck to breath)

(ii) Headlands: Armour rock with smooth surface laid to divert waves or break its' direct impact on the beach, in the form of mound or low height wall about a metre above mean sea level at the shoreline.

(iii) Warning Line: Floating Buoys (with safety net) are generally provided at the end of the Active Beach Area or before start of the deep sea.

Conceptual Layout and Profile are shown in Figures 1 and 2 respectively.Pictorial Views of a Beach under various stages of development are shown in Figure 3.

4. Modeling

- Numerical Modeling is required to study the following:

  (i) Wave and Flow Patterns

  (ii) Sediment Transport and Transportation

  (iii) Residence Time in Basins

  (iv) Water Exchange

  Available commercial software packages for modeling such as UNIBESTVL+, SUTRENCH, SILTHAR, etc. can be used for the above items (ii, iii and iv) while specific software for (i) will have to be developed.

- Physical Modeling will be useful for the above mentioned studies to determine stability of beaches.

5. Conclusions and Recommendations

- Stability of beaches depends upon the local conditions.However it is necessary to take planning, engineering, meteorological, environmental and performance of existing beaches into consideration for new beaches to be created.
- Maintenance effort will be less if beaches are properly designed and constructed.
- Inspection/Monitoring of beaches is very important to carry out timely remedial measures and reduce maintenance effort.
- More research is required for the optimum design of beaches to save construction and maintenance costs.

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GROUNDWATER RECHARGE ESTIMATION IN AN IRRIGATED AREA- A CASE STUDY OF RECHNA DOAB, PUNJAB, PAKISTAN

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ABSTRACT

Indus Basin of Pakistan had been bestowed with extensive groundwater resources which have become a supplement source for irrigation. This study was planned to estimate groundwater recharge which is a key component for groundwater planning and management in an irrigated area of Rechna Doab. Different methods and techniques are available to estimate recharge from different sources including rainfall, river and canal irrigation networks. However, Groundwater Budget Method has been used to estimate seasonal (Rabi & Kharif) recharge from the year 2005 to 2011. The value of estimated average recharge in the study area is 127 mm for Kharif season and 68 mm for Rabi during the period 2005 to 2011. The value of estimated groundwater abstraction was 116 mm in kharif and 115 mm in Rabi season for year 2005 which has reached 131mm for kharif and 128 mm for Rabi season in year 2011 due to unplanned groundwater development and continuous increase in number of private tubewells. The seasonal net average groundwater recharge is negative except positive for kharif season in year 2008, 2010 and 2011. The results indicate that groundwater abstraction is greater than corresponding value of recharge which means aquifer is being depleted on regional basis with the passage of time.

Key Words: Rechna Doab, Water Budget, Groundwater recharge, estimate, Seasonal, Pakistan

INTRODUCTION

Water is essential component of the natural environment and plays a role of backbone for the existence of life on the planet earth. It is a renewable but finite resource and is unevenly distributed with time and space. Water resources are under stress due to rapid growth of population, industrial revolutions, urbanization and extensive agriculture etc. At present, groundwater is used to irrigate one quarter of world's irrigated land, out of which 75 percent of the irrigated land is situated in Asia region (Shah et al. 2007). It was estimated that about 10 percent of the world population is facing shortage of fresh water and about more than 2.8 billion people in 48 countries will face water scarcity conditions by 2025. The number of countries facing water stress or scarcity could rise to 54, with about 40% of the projected global population of 9.4 billion till 2050 (UNEP 2008).

Pakistan, like other 48 countries, will face fresh-water shortage (Saeed 2013) and its population will be increased to about 250 million by the year 2025. Groundwater is the

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prime source which is widely used in domestic, agriculture and industrial sectors, particularly in arid and semi arid areas of Pakistan. Pakistan's economy is linked with agriculture output as the shares of agriculture in GDP is more than 21 percent and employ around 45 percent of the labor force (Economic Survey of Pakistan, 2009-2010).

Punjab is the biggest populated province of Pakistan with an area of about 127,000 km^2. It is called as "The Land of Five Rivers". The rivers are Sutlej, Ravi, Chenab, Jhelum and Indus from east to west. The land between two adjacent rivers is called "doab" and such area between Ravi River and Chenab River is locally called Rechna Doab. For the last 2 to 3 decades, utilization of groundwater resources has been increased because of their wide range distribution and low development cost (Ahmed et al 2005).

Over-exploitation of groundwater has resulted lower water level and deteriorate its quality in the Rechna doab and is increasing continuously on long term basis due to depletion in groundwater reservoir (Hassan & Bhutta 1996; Qureshi et al. 2009; Akhtar 2012). Groundwater recharge studies in Rechna doab have been carried out by different researchers. Hassan (1993) and Ahmad et al. (2002) concluded that recharge in semi-arid regions is a small component of the water balance. Moreover, aquifer recharge is less than groundwater exploitation. During field irrigation through water channels, water losses occur and a part of these water losses contribute to groundwater recharge ultimately (Radfar 2009).

Indus Plain of Pakistan is bestowed with extensive groundwater resources having unconfined aquifer, which has become a supplement source for irrigation due to shortage of water through irrigation system which was initially designed to support cropping intensity of approximately 67 percent which now have increased up to 150 percent, being enabled by additional supplies from groundwater extraction (Ahmed et al 2005). Before the introduction of canal irrigation system, depth to water table was deep and it was 40-100 ft in Rechna Doab but after the development of irrigation system, water levels started to increase and it reached to close of the land surface causing waterlogging and soil salinity (WAPDA 1967). Water and Power Development Authority (WAPDA) launched a program called Salinity Control and Reclamation Projects (SCARP) in 1960 to cater the waterlogging and salinity problems in the country under which thousands of tubewells with large capacity (0.084–0.14 m3 sec-1) were installed to control groundwater level and supplement the irrigation supplies. In early of 1960, numbers of tubwells were one thousand (Qureshi et al. 2003) which increased upto about 0.941 million in 2009 and now numbers of tubewell have reached about 1 million abstracting more groundwater than aquifer recharge. In Punjab, irrigated area has reached from 14.05 million hectares to 15.16 million hectares in the period from 2001 to 2010 (Pakistan Statistical Year Book 2011). The share of crop water requirements from groundwater has increased above 50 percent and during drought period (Rabi period), percentage of groundwater share reached up to 80 percent (Qureshi et al. 2010).

Aquifer of Indus Basin is recharged from natural precipitation, river flow, seepage from irrigation networks and field irrigation. Aquifer is balanced through recharged and discharged by public and private tubewells.

STUDY AREA

Faisalabad is the 3rd largest city of Pakistan and is an industrial hub for the economic

growth of the country. Estimation of groundwater recharge at spatial and temporal scales is required for management and sustainability of hydro-geological system. Therefore, the present study was designed to estimate the net recharge contribution to groundwater from different sources in a typical selected area. The current study has been carried out near Faisalabad and Chiniot districts falling between in Rechna Doab a part of Indus Bain of Pakistan. The geographically location of the study area is lying at latitude 31^0 24' N to 31^0 56' N and longitude 72^0 39' E to 73^0 18' E (Fig. 1a-b).

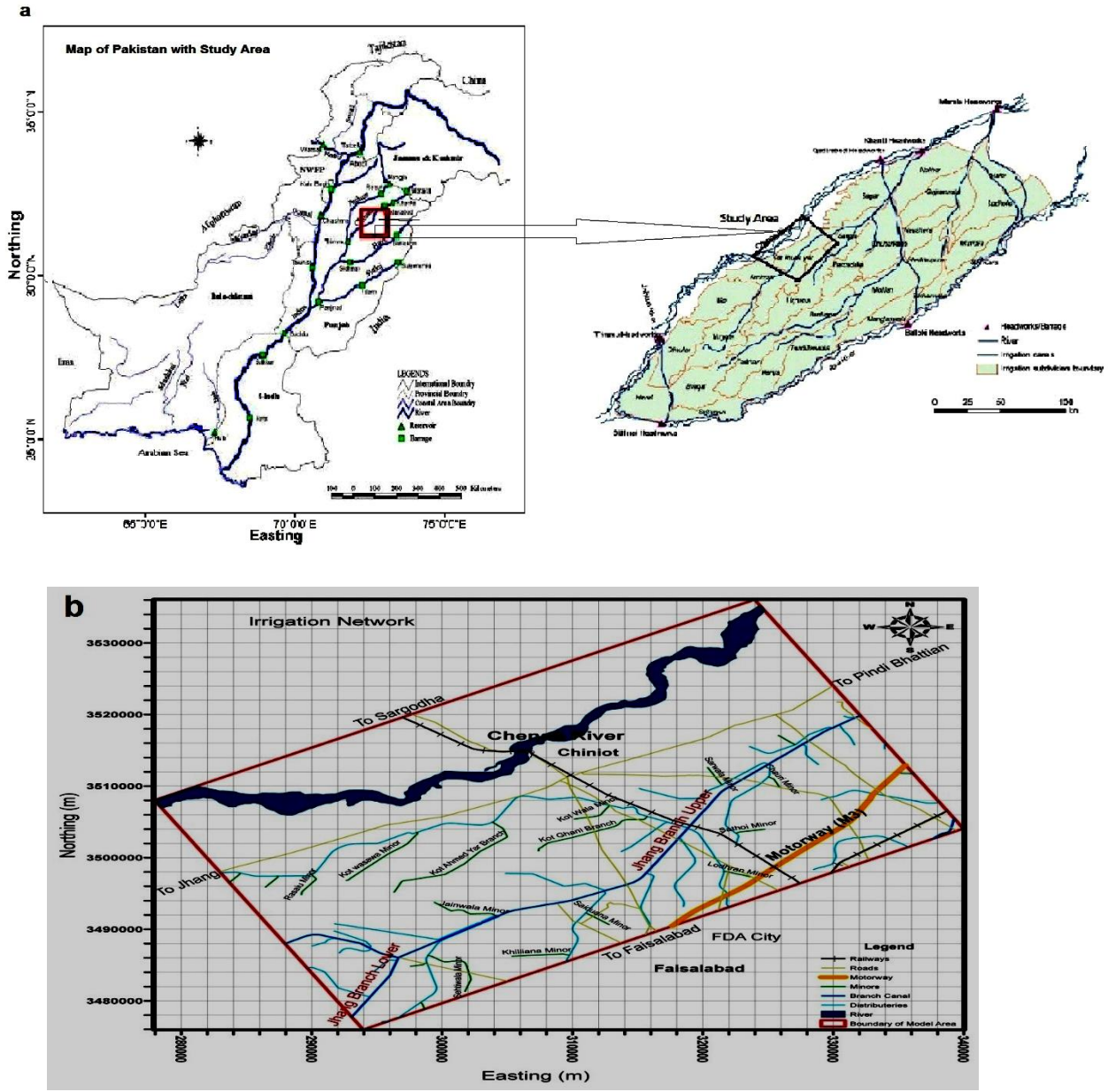


Fig. 1a-b **a.** Location and Boundaries of the Study Area **b.** Irrigation Network

The total area of the study selected for recharge estimation from various sources is 1944 km2. The area has been divided into 484 cells and the area of each cell is 2 km x 2 km. The South-East boundary is located in Faisalabad region while North-West boundary is bounded by the River Chenab. The Study area was selected in such a way that it represents the major features like large irrigation & drainage networks,

extensive agriculture, huge pumpage by private and public tubewells and existence of fresh and saline groundwater zones and different uses of groundwater etc.

The study area consists of arid climate and its climate is characterized by hot summers and cold winters. Kharif and Rabi are two cropping seasons. Kharif season extends from April-16 to October-15 which is monsoon season whereas Rabi is dry season and prevails from October-16 to April-15. Cotton, rice, sugarcane and maize are major crops of kharif season and wheat is main crop of Rabi season (Ahmed 2002).

MATERIAL AND METHODS

In the current study Water Budget Method (WBM) has been used to estimate net seasonal long term groundwater recharge. WBM is a technique that had been used to estimate groundwater recharge and change in storage of an aquifer, change in aquifer potential and to estimate sustainable pumpage etc (Hassan and Bhutta 1996; Njamnsi and Mbueet 2009; Akhtar 2012). Groundwater balance of an aquifer is represented by inflows (recharge components) and outflows (discharge components) in a system. Mathematically, it is represented as under:-

$$I - O = \Delta S \qquad (1)$$

Where, I represent all inflow components from the system, O represents all outflow components from the system and ∆S is the change in storage of the system.

If we consider the aquifer as a system, by spreading above equation in recharge and discharge components, it can be rewritten as under:-

$$Q_{net} = (R_{rf} + R_c + R_{dm} + R_{wc} + R_{fi} + R_r + G_{in}) - (ET + D_{tw} + F_d + G_{out}) \qquad (2)$$

Where, Qnet = Net recharge/change in storage of aquifer, Rrf = Recharge from rainfall, Rc = Recharge from canals; Rdm = Recharge from distributaries and minors, Rw.c = Recharge from water courses; Rfi = Recharge from field irrigation; Gin = Groundwater entering into the system; ET = Evapotranspiration, Dtw= Discharge from public & private tubewells, ; Fd= Flow to drains and Gout = Groundwater outgoing from the system.

The net recharge/change in storage in study area can be estimated by calculating and putting various recharge and discharge components in Eq. (2). Recharge estimation from different components of WBM are as under:-

RECHARGE FROM RAINFALL

Natural replenishment of aquifer by precipitation is governed by type of precipitation, climatic condition, and soil moisture before and after the rainfall, rainfall duration & intensity, topography of natural land surface, soil characteristics, cropping intensity and cropping pattern etc (Hassan 1993). Groundwater recharge is directly proportional to precipitation and vice versa. The data on rainfall was collected from Pakistan Meteorological Department (PMD) for the period 1996 to 2011. Isohytel trends conducted by WAPDA, 1962 for the period 1916-1957 have been used to estimate the cell wise distribution of seasonal rainfall in the study area. It had been estimated that one of third (1/3) of precipitation (33 %) goes to groundwater recharge (Fleeger 1999; Risser 2008). In alluvial norms recharge from rainfall is in range from 22 -25% (CGWB 2009).

It has been assumed that 30% of total rainfall goes into deep percolation. 90 % of this

percolation has been taken as recharge. A uniform recharge factor has been used.

RECHARGE FROM IRRIGATION SYSTEM

Major part of the study area is irrigated by Jhang Branch Canal (JBC) and its tributaries which take water from Chenab River through Lower Chenab Canal (LCC) off taking from the Khanki Headworks on the Chenab River. The LCC is the largest canal system in Punjab and it was put into operation as a perennial canal in 1892 with designed discharge capacity of 11,595 cusecs, 4097 cusecs for Jhang Branch Canal and 7498 cusecs for Gugera Branch Canal. Discharge flow of canals, distributaries and minors was collected from Programme Monitoring and Implementation Unit (PMIU) of Irrigation Department. Groundwater recharge from irrigation system has been estimated at three stages. (i) Recharge from Jhang branch canal, (ii) Recharge from distributaries and Minors and, (iii) Recharge from watercourses and irrigated fields.

Most of the channels are unlined and are the principal component of groundwater recharge. The seepage loss from the canal is a function of canal geometry, aquifer characteristics, canal discharge and depth to watertable etc. WAPDA (1963) used an empirical relationship for canal losses in different doabs. For Rechna and Chaj Doabs the equation is given below:

$$S = cQ^m \qquad (3)$$

Where, S is the seepage loss in cusecs per canal miles, Q is canal discharge in cusecs, and c & m are exponential and were estimated 0.03 and 0.71 respectively. This empirical relationship was used in this study. Irrigation Research Institute (IRI) was measured seepage from Jhang Branch Canal at RD 209+642 to RD 216+852 by using inflow-outflow method (IRI, 2009). Seepage results of IRI were compared with that by using formula given in Eq. (3) which was almost closed.

RECHARGE FROM RIVER

Groundwater recharge from river depends on Water fluxes which related to the degree of connection between rivers and aquifers. The groundwater flows from aquifer to the river when the groundwater head is greater than the river stage, whereas aquifer is recharged when the river stage is greater than the groundwater head (Scanlon et al. 2002).

Hassan (1993) conducted a study in Rechna doab and results revealed that the river contributes recharge to the aquifer. West boundary of the study area was bounded by Chenab River. Data regarding river (heads, bed levels and width at three stations (Qadirabad Barrage, Chiniot Bridge and Trimmu Barrage) were collected from River Survey Division Lahore. Total length of river in study area is 65 km. Width of river (Wriv) was taken as 304 (m) for Kharif and 100 (m) for Rabi seasons. As river stage is greater than the groundwater head, so river recharge the aquifer. Recharge from river has been estimated by applying Eq. (4) & (5).

$$Q_{riv} = C_{riv} (H_{riv} - h) \qquad (4)$$

where, Qriv, represent flow rate between river and aquifer, Hriv is river head (m), h is groundwater head , Briv is river bed (m) and Criv is hydraulic conductance of river bed (m2/day). V.Pisinarasa et al. (2007) used mathematically formula to calculate hydraulic conductance of river (Eq.5).

$$C_{riv} = \frac{K_{riv} . L . W_{riv}}{M_{riv}} \quad \textbf{(5)}$$

Where Kriv is hydraulic conductivity of river bed (m/day), L is length (m) of river in each cell, Wriv is river width (m) and Mriv is river bed thickness.

Groundwater Recharge and Discharge by Tubewells (D_w)

Hydraulic system is balanced by recharge and discharge component. Groundwater is abstracted by the tubewells installed in the field. There were two types of tubewells in the study area.

A- Private Tubewells (Farmer's wells)

B- Public Wells (WASA & JICA Well fields)

Groundwater draft (extraction) by tubewells in large irrigated areas was estimated by applying the statistical method (Utilization Factor UF-Method) which is used to define the relationship between tubewell extraction and tubewell utilization time, as well as site characteristics (NESPAKSGI 1991; Maupin 1999; Central Groundwater Board Faridabad, India 2009). Total draft was estimated by taking discharge rate, utilization factor, operation hours and days. The product of discharge rate, operation hours and days is total draft by one well for a season. Total draft in an area is calculated by multiplying the number of wells with draft by one well.

A - Discharge and Recharge by Farmer's Tubewells

Canal water is insufficient to meet the water requirement of current cropping intensity (150 %). To meet the needs of crop water requirement, farmers installed private tubewells. The installation of tubewell depends on many factors i.e source of energy, farm size, availability of canal water, climatic conditions, soil characteristics, cropping pattern and financial condition of a farmer. Groundwater discharge is the most important component of water balance equation which plays a pivotal role in groundwater management for future scenario. According to available data, numbers of private tubewells installed in Punjab are more than 945 thousand and out of which 942 thousand are private tubewells (Fig. 2). Numbers of private tubewells in the study area were 4749 in year 2005 which have been increased upto 5420 in year 2011. Discharging capacity of tubewells is in range from 0.75 cfs to 1.25 cfs and operation factor is taken as 25%. Farmer's tubewells have not such negative impacts on aquifer as imposed by well field of WASA for public supply. 15% losses of return flow from private tubewells have been observed through seepage and 60% of the seepage losses are assumed to contribute aquifer recharge.

B- Public Wells (WASA & JICA Well fields)

WASA, Faisalabad (1992) installed twenty nine (29) tubewells in the area of Chiniot, on right side of JBC at a depth of 400-450 feet with 4 cfs discharging capacity to supply water for drinking and industrial purpose especially in the area where groundwater is saline to brackish. The groundwater of Faisalabad is saline to brackish and it is not fit for drinking. Therefore wells were installed near the river and canals bank to capture recharge through seepage.

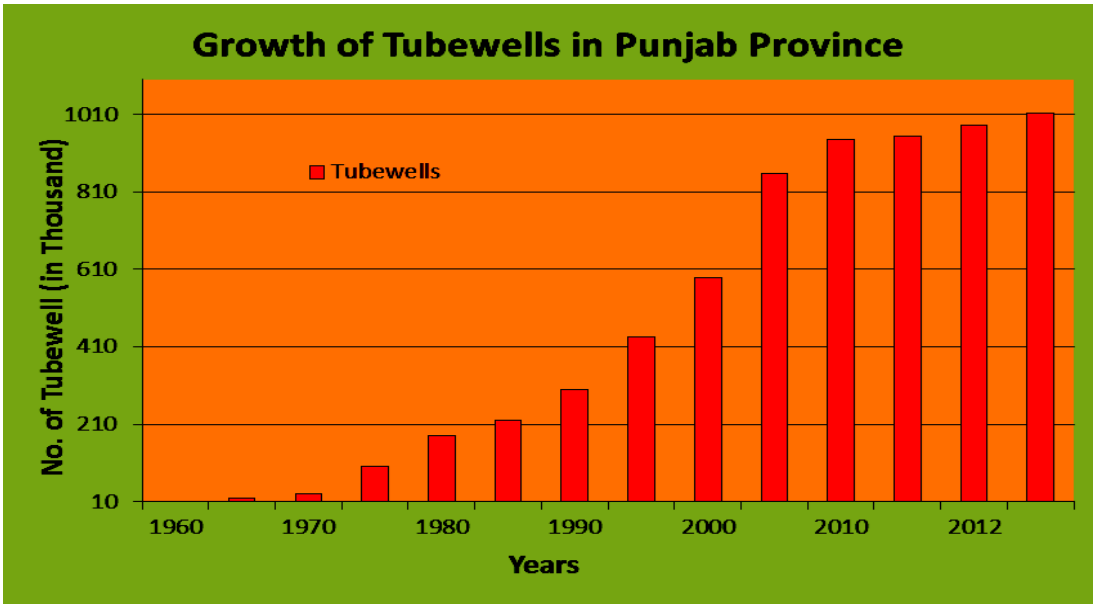


Fig. 2 Growth of Private Tubewells in the Punjab for Years 1960-2013
Source: Directorate of Agriculture Crop Reporting Service, Punjab, Lahore and Punjab Development Statistics annual reports Year (2013)

Net groundwater recharge has been calculated by adding recharges from all five sources (rainfall, canal, distributaries/minors, watercourses & field irrigation and return from private tubewell). Similarly groundwater abstraction has been calculated by adding abstraction sources (Private Tubewells and Public well fields

GROUNDWATER LEVELS

The spatial and temporal measurement of groundwater level helps in finding recharge and discharge rate in the aquifer which was used in groundwater monitoring and management (Healy and Cook 2002) and groundwater recharge estimation (Shamsudduha et al 2011).

A numbers of observation well/monitoring were installed in Rechna Doab to observe seasonal water level variations. Sixty five (65) observation wells were selected in the study area with record of observed seasonal water levels. Observation wells were installed at shallow depth with mean depth approximately 30 m below NSL. These observation wells are being monitored by SCARP Monitoring Organization (SMO-WAPDA), Directorate of Land Reclamation (DLR) Irrigation Department. Data on groundwater table were collected on bi-annual basis i.e. for pre monsoon (June) and post-monsoon periods (October).

RESULTS AND DISCUSSIONS

For assessment of net groundwater recharge, it was essential to evaluate all inflows and out flows components in the study area.

GROUNDWATER RECHARGE

Main recharge sources in the study area are rainfall, canal seepage and field irrigation. Data regarding rainfall, seepage from canals, distributaries and minors, and field irrigation were analyzed to find out groundwater recharges from these recharges sources. The average seasonal groundwater recharge from rainfall, irrigation network (canal seepage), field irrigation and returned from farmer tubewells tabulated in Table 2 are discussed below.

RAINFALL

Rainfall plays significant role in groundwater recharge and irrigation. The long term average annual rainfall in Faisalabad is range from 356 to 374 mm (Table 1). The data for average monthly precipitation in the study area has been represented graphically in Fig. 3 which indicates that 70% of the total rainfall occurs during monsoon season in months of July and August and lowest rainfall has been observed in the months of January and February during Rabi season. Therefore groundwater levels were increased after monsoon due to more recharge from rainfall while lower in Rabi season. It is clear from data that there is spatial and temporal variation in rainfall respectively.

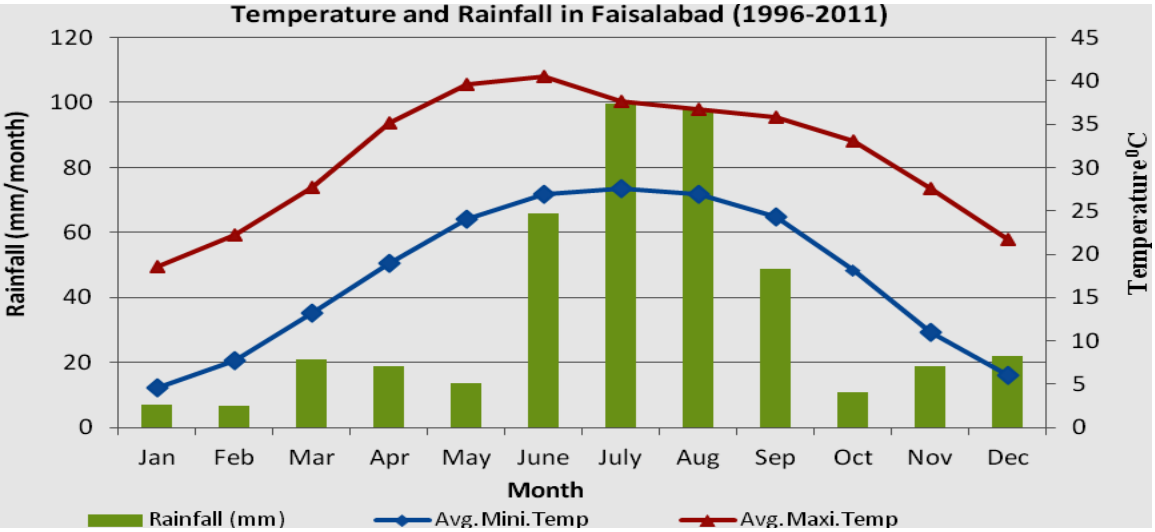


Fig. 3 Temperature and Rainfall Trend in Study area (Faisalabad)

Source: Pakistan Meteorological Department

IRRIGATION SYSTEM

Irrigation network system of the study area is consisted main Jhang Branch Canal (RD 143 to RD 308), its distributaries/ minors and water courses which not only supplies surface water for irrigation purpose but also contributes to aquifer recharge through seepage. Average recharge from main Jhang Branch Canal has been estimated about 85 MCM in Kharif and its value for Rabi is about 72.0 MCM. The reason for lower value of recharge in Rabi seasons is due to closing of Jhang Branch Canal during the month of January and less flow in the Chenab River and less rainfall.

Aquifer always tends to achieve equilibrium state provided there is no change in recharge and discharge components for a considerable period of time. The difference between all inflows and outflows of the area is equal to net change in storage per unit of time. If net change in aquifer storage is positive, watertable will rise but in case of negative change in aquifer storage, watertable will decline. Negative balance means that discharge rate is higher than recharge rate. In case net change in storage is zero, the watertable will neither fall nor rise. The net recharge in the aquifer from rainfall, irrigation network and discharge from tubewells measured by using water balance method Eq. (2) has been represented in Table 2.

Table 2: Seasonal Groundwater Balance Sheet (2005-2011)

Sr. No	Seasons	Ground Water Recharge (MCM) by Different Sources					Total Recharge (MCM)	Discharge by Tubewells (MCM)	Net Balance (MCM)
		Rainfall	Main Canal	Distributary/Minors	Water Courses/Irrigation Field	Irrigation Tubewell			
1	Kh-2005	182.96	89.61	0.0031	120.53	36	429.1	432.49	-3.39
2	Rabi(2005-06)	28.18	71.44	0.0029	102.25	36	237.87	429.21	-191.34
3	Kh-2006	163.9	89.34	0.0032	131.15	37	421.39	441.46	-20.07
4	Rabi(2006-07)	70.82	72.01	0.003	107.32	36	286.15	438.13	-151.98
5	kh2007	143.91	91.56	0.0032	132.59	38	406.06	450.63	-44.57
6	Rabi(2007-08)	39.59	70.13	0.0029	101.52	37	248.24	447.25	-199.01
7	kh-08	282.99	88.66	0.0032	130.32	38	539.97	460	79.97
8	Rabi(2008-09)	33.13	59.72	0.0028	87.24	38	218.09	456.57	-238.48
9	kh-2009	176.49	86.48	0.0031	124.77	39	426.74	469.38	-42.64
10	Rabi(2009-10)	14.39	65.7	0.0028	92.24	39	211.33	465.9	-254.57
11	Kh-2010	286.19	80.24	0.003	116.43	40	522.86	478.96	43.9
12	Rabi(2010-11)	26.07	71.9	0.0029	101.46	40	239.43	475.43	-236
13	kh-2011	277.07	86.79	0.003	115.05	41	519.91	488.75	31.16

The data indicate positive balance only in those years in which rainfall was higher than average annual rainfall rate. The average groundwater recharge to be estimated in Kharif seasons for the period from 2005 to 2011 is in the range of 109 mm to 145 mm with average value 127 mm. Similarly, estimated recharge for Rabi seasons for same periods is in the range from 59 mm to 77 mm with average value of 68 mm.

Moreover, it has also been observed that there is more abstraction as compared to recharge in Rabi seasons because less rainfall, less flow in river and canals and more pumpage due to insufficient canal water supply for crops.

GROUNDWATER ABSTRACTION

Groundwater discharge is the most important component of water balance equation which plays a pivotal role in groundwater planning and management studies for future scenario. Groundwater abstraction by farmer (private) tubewells as well as by Public tubewells has been estimated.. Data represented in Table 3 shows that main stresses on groundwater in the study area are pumpage by existing WASA well-field (33.86 & 32.76 MCM per season) and pumpage by private farmer tubewells which are increasing every year. It has also been observed that numbers of private tube wells are increasing annually. The availability of water from canals will remain almost same but groundwater abstraction for agriculture would be increased. It is pointed out that farmer tubewells are scattered more or less in the whole study area and their impact

is uniformly distributed over the whole study area. Moreover, some part of groundwater abstracted by private tubewells is returned back to aquifer. Seasonal estimated pumpage through private and public tubewells in the study area for the period from 2005 to 2011 is given in Table 3.

Table 3: Groundwater Pumpage by Public and Private Tubewells in Study Area

Sr. No	Season	No. of Private Tubewells	Pumpage by Private Tubewells (MCM)	No.of WASA Tubewells	Pumpage by WASA Old Well-field (MCM)	Total Pumpage by Tubewells (MCM)
1	Kharif-2005	4749	398.63	29	33.86	432.49
2	Rabi(2005-06)	4749	396.45	29	32.76	429.21
3	Kharif-2006	4856	407.60	29	33.86	441.46
4	Rabi(2006-07)	4856	405.37	29	32.76	438.13
5	Kharif-2007	4965	416.77	29	33.86	450.63
6	Rabi(2007-08)	4965	414.49	29	32.76	447.25
7	kharif-2008	5077	426.14	29	33.86	460
8	Rabi(2008-09)	5077	423.81	29	32.76	456.57
9	kharif-2009	5189	435.52	29	33.86	469.38
10	Rabi(2009-10)	5189	433.14	29	32.76	465.9
11	Kharif-2010	5303	445.10	29	33.86	478.96
12	Rabi(2010-11)	5303	442.67	29	32.76	475.43
13	kharif-2011	5420	454.89	29	33.86	488.75

The estimated groundwater abstraction through public and private tubewells is 116 mm and 115 mm in kharif and Rabi season respectively for the year 2005 and now during 2011, it has reached up to 128 mm and 131mm in Rabi and kharif season due to continuous increase in number of private tubewells. The net groundwater extraction in Lower Canal Command area of Rechna doab was found -100 mm per year (1993-94) by using remote sensing techniques showing replenishment of aquifer (Ahmed et al 2005) which are 100% are less to this research results because that time farmer tubwells were less but now development of private tubewell has increased three time

fold. Results tabulated in Table 2 indicate that net average groundwater recharge for Kharif and Rabi seasons is negative except positive value for kharif seasons in year 2008, 2010 and 2011. The results indicate that groundwater exploration is greater than corresponding value of recharge. It means, aquifer is being depleted on a regional basis with the passage of time.

Existing WASA well field is putting a concentrated stress on the groundwater reservoir which has caused serious depletion of groundwater. It has been observed that groundwater level near old WASA well fields are going down continuously with average rate up to 0.9 m annually. As study area is intensively agricultural land, hence the impact of wellfields on environment is not favorable for farmers. Socio-economic and environmental impact has been developed in the study area that is not favorable for farmers that cultivate food and fibers for the people of Pakistan. Constructional and operational cost of private tubewells has increased and will be further increased due lowering of depth to watertable.

MEASUREMENT OF GROUNDWATER LEVEL

To observe groundwater level in the area, 64 observation wells were selected for actual measurements. Location of monitoring wells has been checked by field visits and plotted by using computer software Arc GIS 9.3 (Fig. 4).

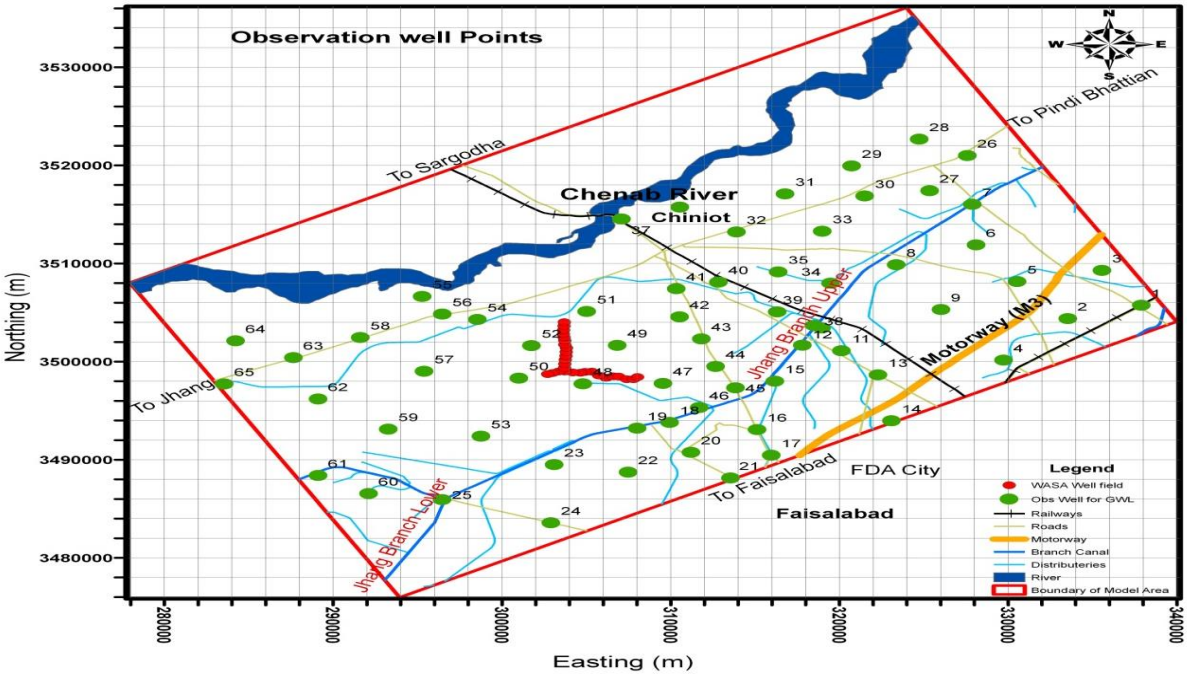
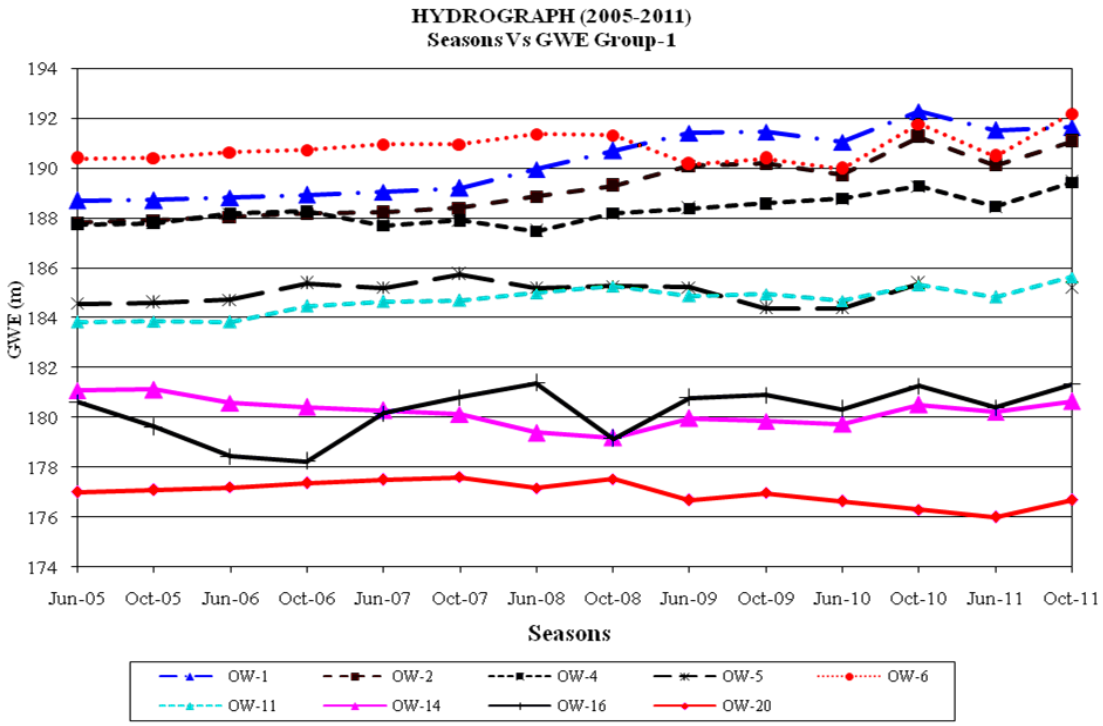


Fig. 4 Locations of Groundwater Observation Wells in the Study Area. Green circles indicate the location of monitoring well and red circles indicate Old WASA Wells

The data for depth to groundwater table collected from different sources i.e SMO, DLR and actually observed in the field. Data for depth to watertable has been converted into groundwater level. Groundwater levels have also been analyzed for frequency, distribution, consistency and reliability. Hydrographs of the observation wells in different groups were plotted in Figure 5. Groundwater levels are referenced to a common datum (Public Works Datum, PWD) which was originally set to the mean sea level (msl). Groundwater levels play role to estimate groundwater recharge in the aquifer. Measured and calculated groundwater elevations have been compared for

validation of net recharge (Fig 6a-k).

Hydrographs of observed and calculated through specific yield method for the period from 2005 to 2011 have been compared. Groundwater elevations calculated through specific yield method have been compared with actually observed groundwater elevation. Value of observed and calculated of groundwater elevations are in similar trends. This indicates the accuracy of estimation of groundwater recharge through groundwater balance method.



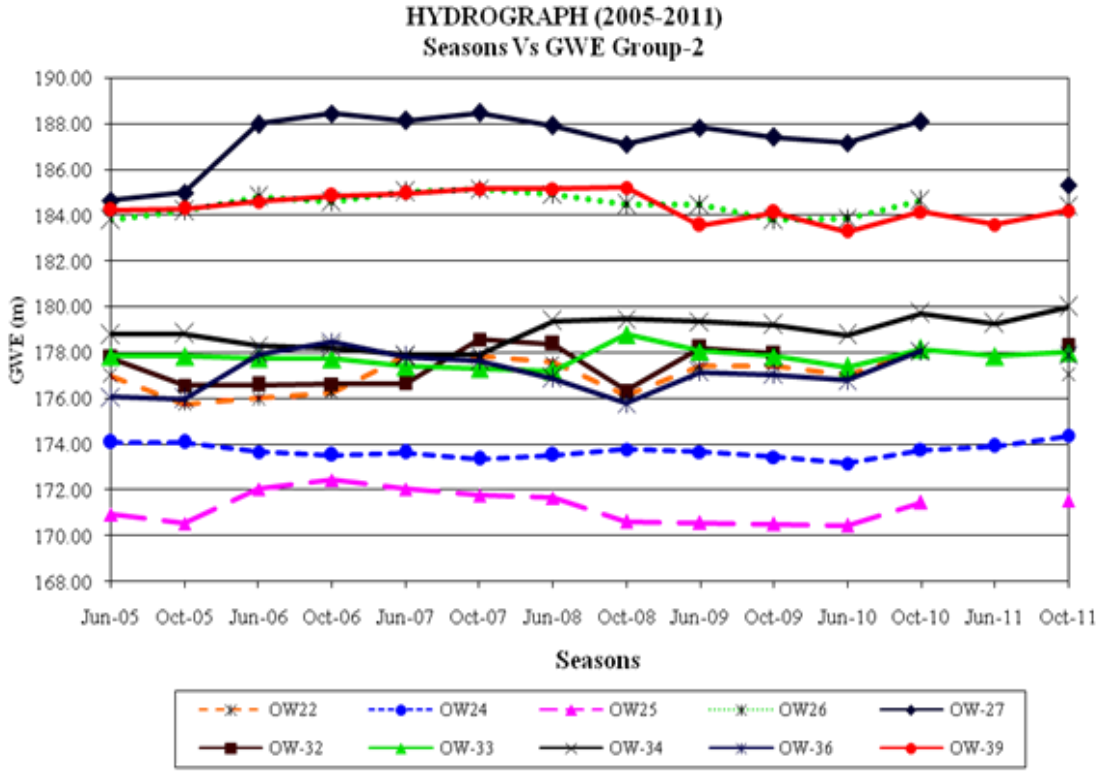


Fig. 5: Hydrograph of Observed Groundwater Elevation for Period 2005-2011 (group 1&2)

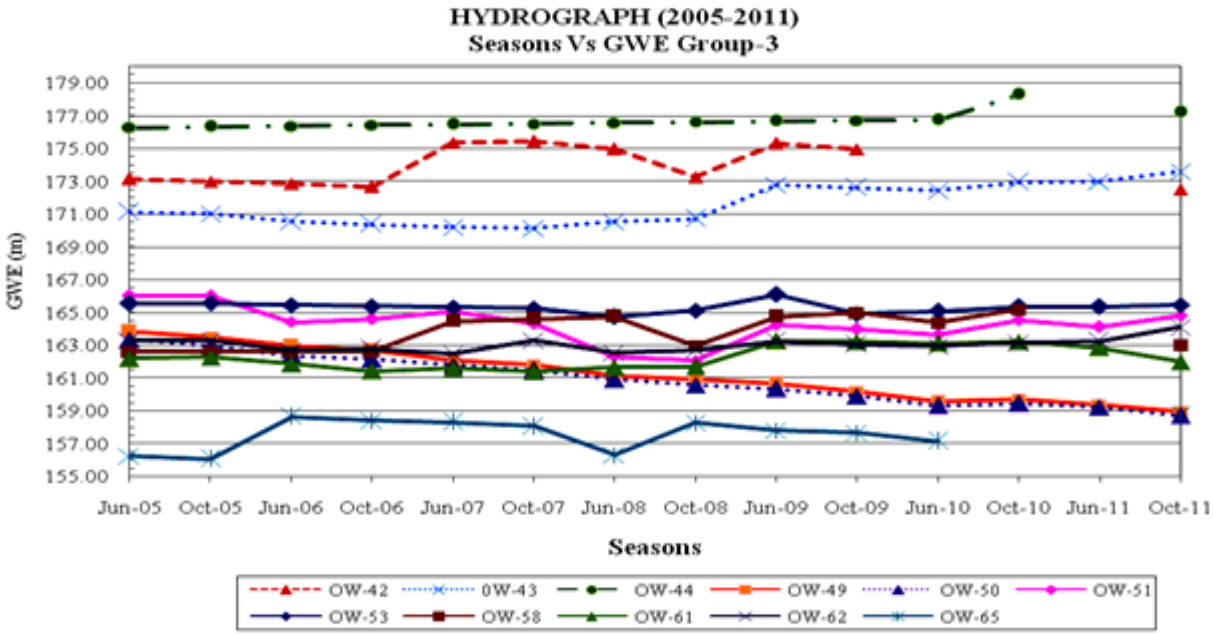
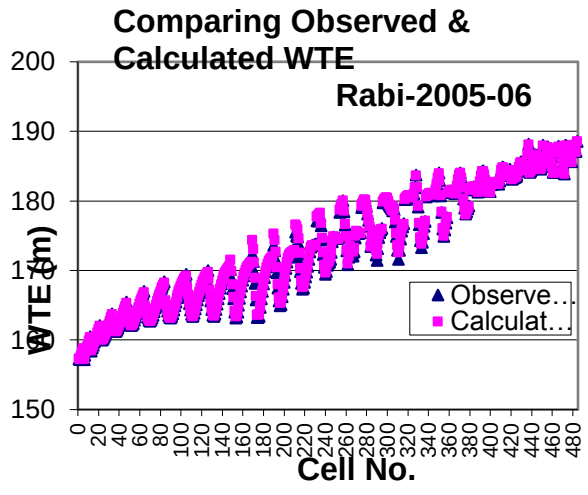


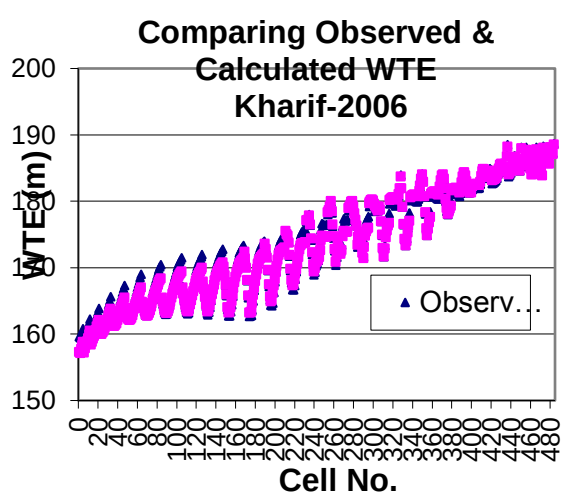
Fig. 5: Hydrograph of Observed Groundwater Elevation for Period 2005-2011 (group 3)

Hydrograph shows spatial and temporal variations of groundwater level. Location of the monitoring well indicates the spatial variation of groundwater level while seasons show the temporal variation. Reason of lower groundwater level in Rabi Season may be due less rainfall and shortage of flow in river. While in kharif Season the case is inverse i.e more rainfall occurs in monsoon season (June to August) and more water flow in river, consequently more groundwater recharge. Moreover, it has also been observed that water levels are higher in observation wells located near canal and river due recharge through seepage.

a



b



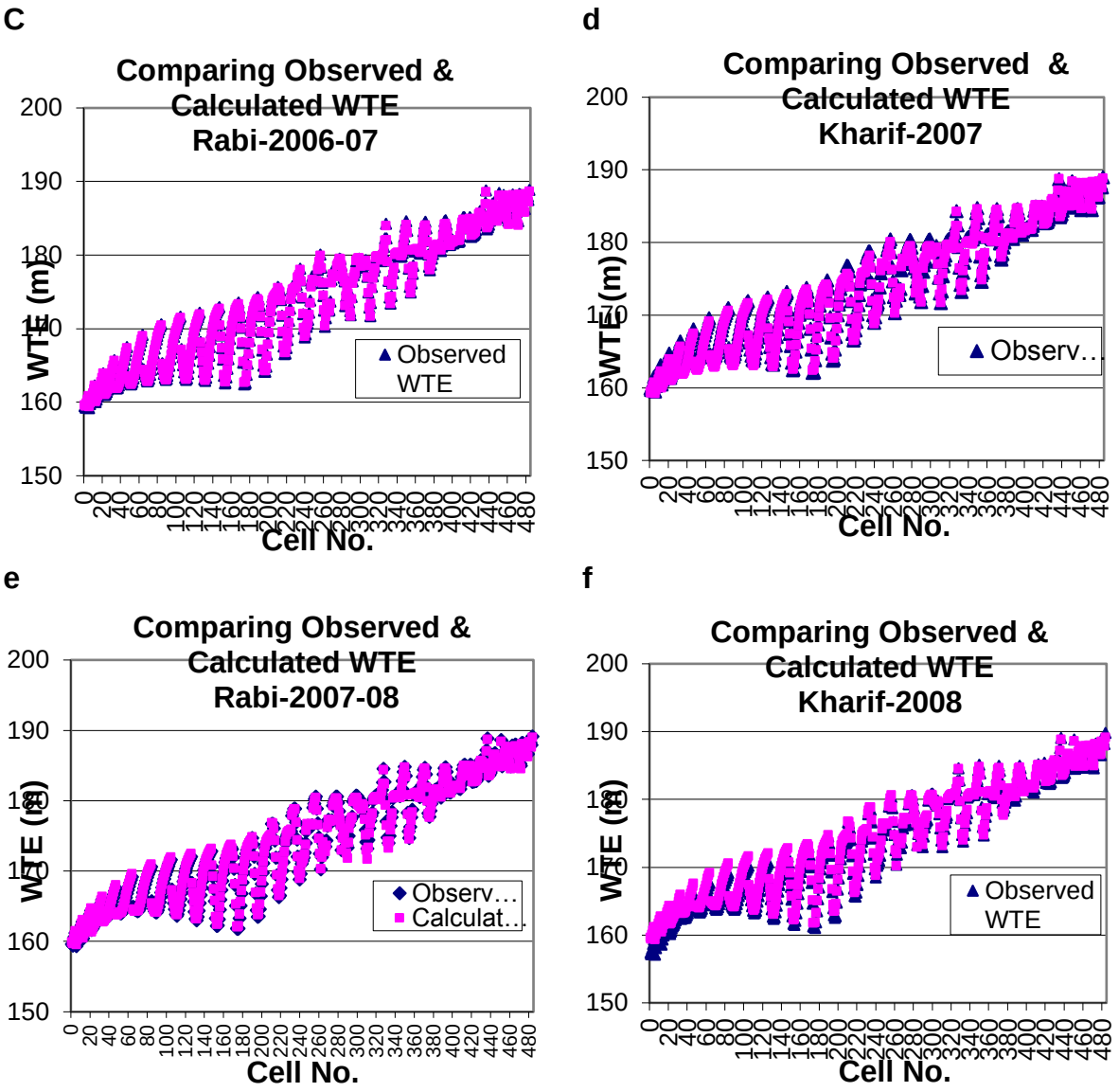
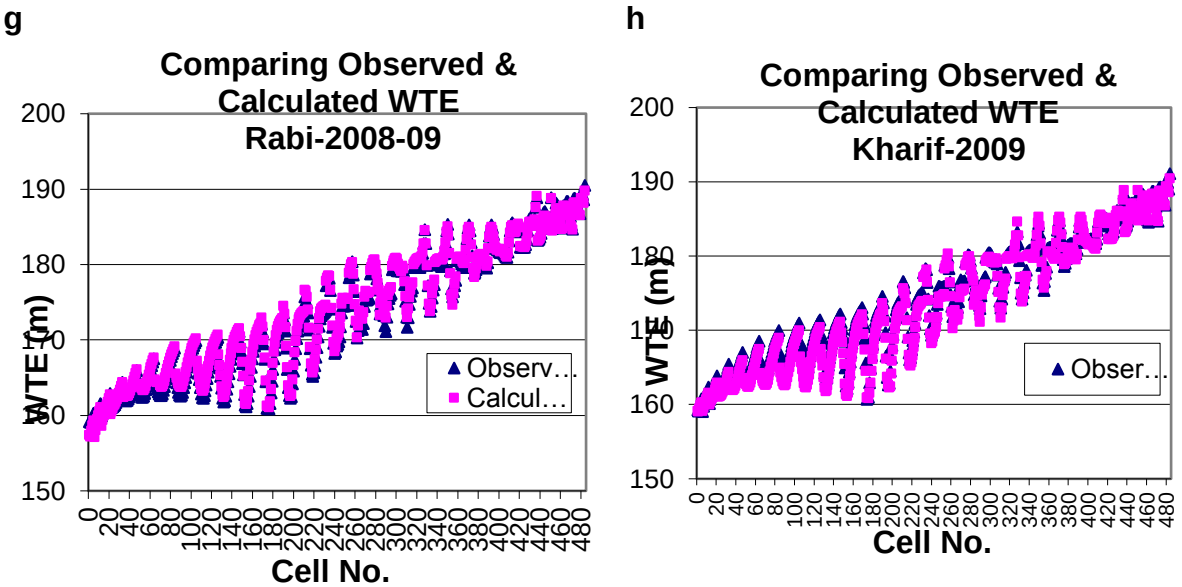


Fig.6a-f Hydrograph of Observed and Calculated Groundwater Elevation



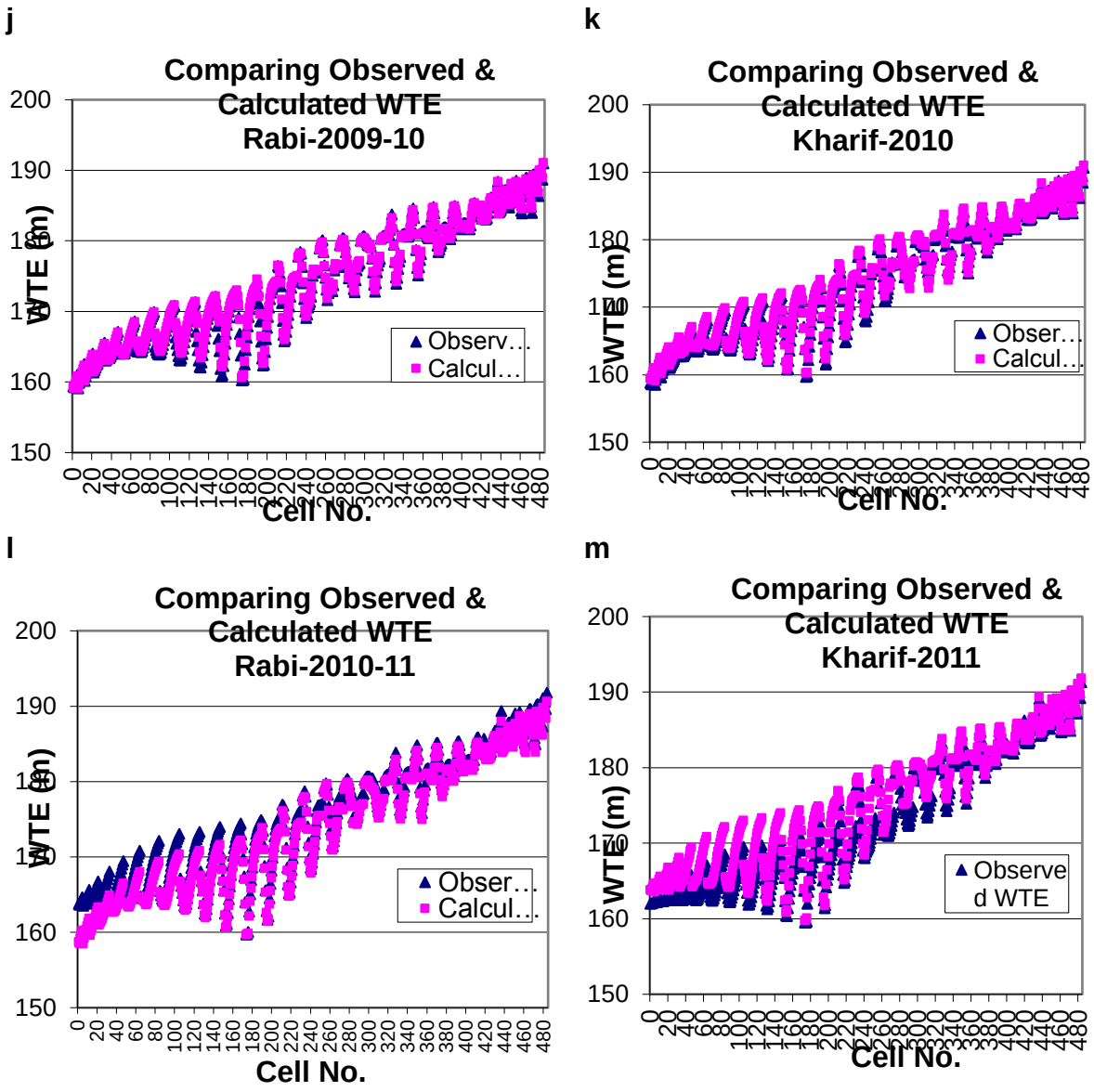


Fig. 6g-m: Hydrograph of Observed and Calculated Groundwater Elevation

CONCLUSIONS

Recharge to groundwater reservoir has been estimated by groundwater balance method. Moreover, observed water levels have been compared with groundwater levels calculated through specific yield method. In the specific yield method, the results depended on the observed water level and the aquifer specific yield. It is concluded that groundwater fluctuates with time and space markedly. Water level rises in wet seasons (after monsoon) and then drops in dry season (before monsoon). Rainfall and canal irrigation system are contributing significantly to groundwater recharge, with variation in time and space. Groundwater abstraction rate is more, especially in existing well field, than aquifer recharge rate due to which groundwater level is declining continuously. The average recharge from rainfall and canal irrigation system has been estimated to be in the range from 109 mm to 145 mm with an average value of 127 mm in Kharif season for the period from 2005 to 2011. Similarly recharge for Rabi season during year 2005 to 2011 is in the range from 59 mm to 77 mm with an average value of 68 mm. While estimated an average groundwater abstraction through public and private tubewells is 116 mm and 115 mm in kharif and Rabi season for year 2005 and it has reached 131mm and 128 mm in kharif and Rabi season of 2011 due to continuous increase in number of private tubewells. Groundwater level near old WASA well fields are going down continuously with average rate up to 0.9 m annually. Net average groundwater recharge for Kharif and Rabi season is negative except positive for kharif season in 2008, 2010 and 2011. The results from this study indicated that groundwater abstraction is greater than corresponding value of recharge. Therefore, aquifer is being depleted on regional basis with the passage of time.

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