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The Pakistan Civil Engineer

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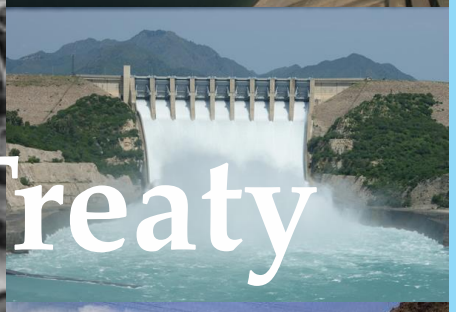
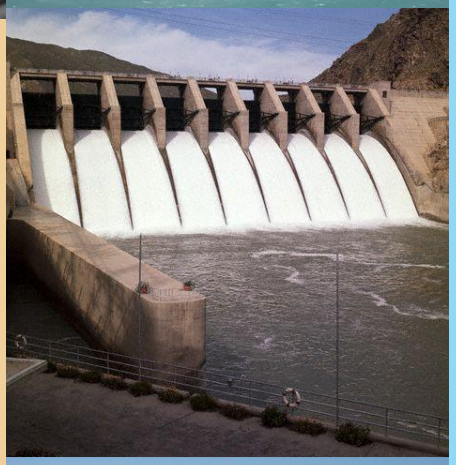
Cover Story

Indus Water Treaty





The Pakistan
Civil Engineer

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PSCE

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Editorial

The editorial board of Pakistan Civil Engineer congratulates its readers on being the first ones to receive the first-ever issue of the magazine. In all humbleness, the board is also cognizant of the burden that has been placed on its shoulders.

Practically working from their own office desks, the members of the editorial team can not lay any claim on having been able to compete with publications of similar resourceful organizations some of which were started decades ago. The only thing that the board can claim is that it has tried to do its best within the available time and meagre resources. The team also promises to continuously strive to improve on the format, content and editorial quality,

A country, richly endowed with a natural system of rivers, a diverse ecology, four seasons and myriad climate setting, Pakistan is inching towards a water crisis. Starting with this issue of its magazine, PSCE intends to place the issue of Indus Waters Treaty in perspective. The debut issue the Pakistan Civil Engineer has been especially chosen to provide a historical perspective into the genesis of the Indus Waters Treaty.

While no claim on originality can possibly be made, PSCE only hopes that through its modest effort, at least the treaty would be placed before the civil engineering community, as impartially as is humanly possible, so that it can make an informed opinion.

It is and would continue to be the editorial policy of this magazine to steer clear of polarized national politics and provide a purely balanced professional viewpoint, cutting across geographical boundaries, on matters of interest to the civil engineers.

We wish a happy reading to the civil engineering community and stay eager to receive its feedback containing constructive suggestions that can help improve the quality of this magazine.

Rizwan Mirza
Editor-in-chief

Cover Story

The Indus Waters Treaty

Rizwan Mirza[1]

The Indus Basin River System

Pakistan is endowed with one of the largest river systems of the world. For thousands of years these rivers have continued to irrigate the land, around which a great civilisation began.

This system is known as the Indus system, after the name of the mighty Indus in which all of its tributaries from the north fall.

The crops of Punjab, Sindh and Khyber Phaktoon Khwa largely depend upon the water of this system for irrigation.

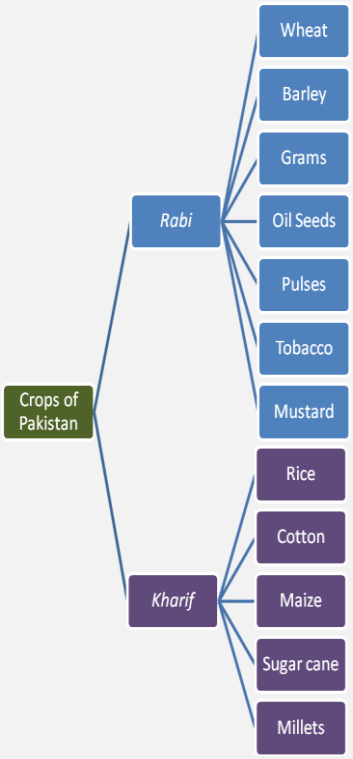
The rivers have small cross-sections and sharp slopes in the north and assume large cross-sections and gentle slopes as they move towards the south.

These rivers – like many other in the world – depend upon glacier-melt, snowmelt and direct rainfall in the catchment area, as their source of water. As one would expect, the water flow remains seasonal. It brings in huge quantities of water in the monsoon season for the *kharif* crops such as rice, cotton, and millet (mid-Aril to mid-October). The river flows are at their lowest ebb in the winters, when water is required for the *rabi* crops such as wheat, maize, gram, mustard, and barley (mid-November to April/May).

These rivers transport more than 80% of the water during monsoons as the rivers overflow leading to heavy floods.

Pakistan is thus, required to even off the flows through water storage. But as things stand, Pakistan has failed to construct the required number of dams resulting in three outcomes: onslaught of floods during monsoons; wastage of this water to the sea; and reduction in availability of water during the low-flow season.

The area presently comprising Pakistan had always enjoyed the lower riparian water rights from times immemorial, until water disputes erupted between Pakistan and India and a treaty was signed between Pakistan and India.



[1] CEO, Rizwan Mirza, Consulting Engineers

The Genesis of Indus Waters Treaty

Since 1919, the distribution of Indus water between various riparian provinces has been a source of disputes. Partition placed India at a vantage point as an upper riparian, with respect to the rivers that flowed into Pakistan. With many canal head-works located in its territory, India stopped inflow of water into Pakistan, on 1st April, 1948.

The dispute was, for the moment, resolved through an interim arrangement. Bilateral negotiations, between the two nascent states, followed but failed. The situation turned from bad to worse and the bilateral issue soon dragged into its wake other parties.

The complex interplay of various actors that ultimately helped lead the two countries to a solution remains shrouded in history. This article sifts through history pages and puts the various facts together in order to provide a much-needed and interesting perspective to the readers.

David Eli Lilienthal, former Chairman, Tennessee Valley Authority (TVA) and former Chairman, United States Atomic Energy Commission

The melting point that was created following the water wars in the Himalayan region was spotted by David E. Lilienthal, when he was commissioned by Collier's magazine, to visit the region. Lilienthal had the right credentials, as he was the former Chairman of TVA, which was a huge success story of a huge corporate experiment involving seven south-eastern states viz. Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee and Virginia.

Lilienthal wrote an article, captioned "Another Korea in the Making", in the August, 1951 issue of the Collier's magazine. *'Pakistan could be devastated by the simple expedient of India's permanently shutting off the source of waters"*, wrote Lilienthal.

> ***"India and Pakistan today are on the very razor edge of a war that would involve more than 360,000,000 people, one sixth of the world's population, and might well set fire to the whole Moslem world from the Arabian Sea to the Valley of the Nile."***
>
> ***David Eli Lilienthal***

David Eli Lilienthal's article, appearing in Collier's magazine

The writer underlined the significance of the presence of communist countries in the

neighbourhood and suggested that since the United Nations had already taken notice of the Kashmir dispute, the US may be well-advised to play its role.

A lawyer by training, the writer analysed the technical issues involved and also suggested a solution. He noted that out of Indus Basin's canal irrigated land, Pakistan had 18,000,000 acres while India had about 5,000,000 acres; yet India had 20,000,000 people living in the Indus basin, almost as many as Pakistan's 22,000,000. He noted that India had yet another 35,000,000 acres of land on its side of the Indus basin land, which offered good potential if irrigated.

The writer also appreciated concerns on the part of Pakistan upon the construction of new irrigation and hydropower development projects, as the river water so withdrawn would have flown to Pakistan were it not for such withdrawal. The writer noted that he had visited one dam that had already been completed and another – Bhakra – had been planned to be higher than the Hoover Dam in the US and was expected to store the entire flow of Sutlej water, for one year.

The writer went on with details of specific facts, repeatedly underlining the purely engineering nature of the issues that demanded a lot of common-sense and an engineering approach for their solutions.

Lilienthal suggested that the Indus Basin system may well be run as the seven-state TVA system that was successfully working in the US.

He was of the opinion that if India agreed taking the dispute to International Court of Justice, it was expected to lose as Pakistan had unalienable right to uninterrupted water flows, as a lower riparian. But he thought that while everyone must recognise Pakistan's position as legitimate, a long term political solution must be found in order to placate India which feared water shortages for its large population.

As such, the solution he advocated was expected to be underpinned by wider political logic rather than strict enforcement of legal rights alone – a policy of appeasement, one would say.

Lilienthal suggested the formation of an Indo-Pak Indus Engineering Corporation, with experts from World Bank, for preparing a plan for storing water wherever dams could best store them and then for diverting and distributing water. After the system was in place, it could be operated by a supranational international agency or by a special corporation.

The writer believed that the scheme proposed by him not only had political and technical merit but was also economically feasible as the lands the wasted water hoped to irrigate held immense financial potential.

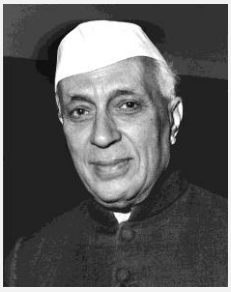
Eugene Robert Black, President International Bank for Reconstruction and Development (IBRD)

Eugene Robert Black, the then-president of the World Bank, was enamoured of the scheme, when it was brought to his notice. In September, 1951, he wrote to the prime ministers of India and Pakistan offering "*the Bank's good offices for discussions of the Indus water dispute and negotiation of a settlement*".

The letter was based on the broad outline concepts developed by Lilienthal:

a) Acceptance that, if properly utilised, the water resources of Indus Basin were adequate for immediate and projected needs
b) The solution shall be developed in a spirit of co-operation, treating the basin as an organic whole, cutting across political boundaries
c) The solution shall be evolved on technical rather than political grounds

Liaquat Ali Khan, Prime Minister of Pakistan



Jawaharlal Nehru, Prime Minister of India

International Bank for Reconstruction and Development (IBRD) (presently the World Bank), then came in as a broker and the negotiations resulted in the Indus Waters Treaty, signed on 16th September, 1960, between Shiri Jawahar Lal Nehru, Prime Minister of India and Muhammad Ayub Khan, President of Pakistan.

Jawaharlal Nehru, Muhammaf Ayub Khan and representative of IBRD

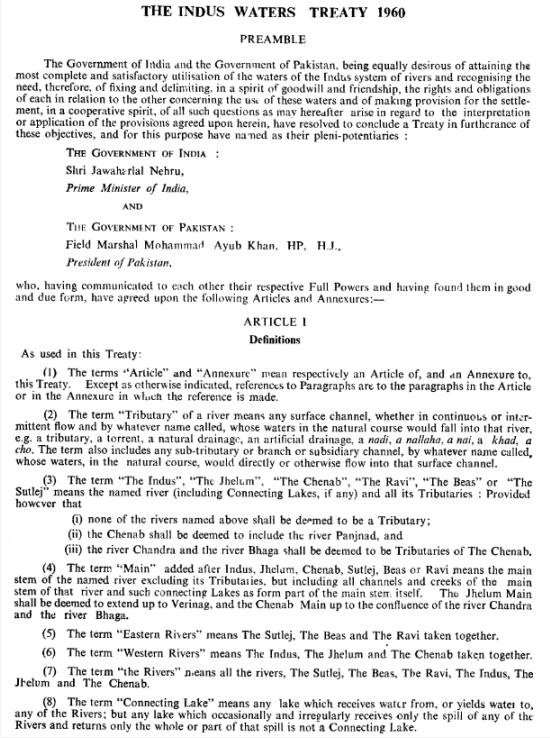
Key Provisions of Indus Waters Treaty

The treaty has a Preamble, 12 Articles, I to XII and 7 appendices, A to H.

Article	Description
Article-I	Definitions
Article-II	Provisions Regarding Eastern Rivers
Article-III	Provisions Regarding Western Rivers
Article-IV	Provisions Regarding Eastern Rivers and Western Rivers
Article-V	Financial Provisions
Article-VI	Exchange of Data
Article-VII	Future Co-operation
Article-VIII	Permanent Indus Commission
Article-IX	Settlement of Differences and Disputes
Article-X	Emergency Provision
Article-XI	General Provisions
Article-XII	Final Provisions

Under the Indus Waters Treaty, rights of three western rivers, viz. Indus, Jhelum and Chenab were assigned to Pakistan while those of the three eastern rivers, viz. Ravi, Sutlej and Beas, were assigned to India. But, as we would note, these rights were not unqualified.

The treaty established a permanent two-member commission, with one member nominated by each state party, for cooperating on management of the issues related to the issue.



THE INDUS WATERS TREATY 1960

PREAMBLE

The Government of India and the Government of Pakistan, being equally desirous of attaining the most complete and satisfactory utilisation of the waters of the Indus system of rivers and recognising the need, therefore, of fixing and delimiting, in a spirit of goodwill and friendship, the rights and obligations of each in relation to the other concerning the use of these waters and of making provision for the settlement, in a cooperative spirit, of all such questions as may hereafter arise in regard to the interpretation or application of the provisions agreed upon herein, have resolved to conclude a Treaty in furtherance of these objectives, and for this purpose have named as their plenipotentiaries :

THE GOVERNMENT OF INDIA :
Shri Jawaharlal Nehru,
Prime Minister of India,
AND
THE GOVERNMENT OF PAKISTAN :
Field Marshal Mohammad Ayub Khan, HP, H.J.,
President of Pakistan,

who, having communicated to each other their respective Full Powers and having found them in good and due form, have agreed upon the following Articles and Annexures:—

ARTICLE I
Definitions

As used in this Treaty:

(1) The terms "Article" and "Annexure" mean respectively an Article of, and an Annexure to, this Treaty. Except as otherwise indicated, references to Paragraphs are to the paragraphs in the Article or in the Annexure in which the reference is made.

(2) The term "Tributary" of a river means any surface channel, whether in continuous or intermittent flow and by whatever name called, whose waters in the natural course would fall into that river, e.g. a tributary, a torrent, a natural drainage, an artificial drainage, a *nadi*, *a nallaha*, *a nai*, a *khad*, *a cho*. The term also includes any sub-tributary or branch or subsidiary channel, by whatever name called, whose waters, in the natural course, would directly or otherwise flow into that surface channel.

(3) The term "The Indus", "The Jhelum", "The Chenab", "The Ravi", "The Beas" or "The Sutlej" means the named river (including Connecting Lakes, if any) and all its Tributaries : Provided however that

(i) none of the rivers named above shall be deemed to be a Tributary;
(ii) the Chenab shall be deemed to include the river Panjnad, and
(iii) the river Chandra and the river Bhaga shall be deemed to be Tributaries of The Chenab.

(4) The term "Main" added after Indus, Jhelum, Chenab, Sutlej, Beas or Ravi means the main stem of the named river excluding its Tributaries, but including all channels and creeks of the main stem of that river and such connecting Lakes as form part of the main stem itself. The Jhelum Main shall be deemed to extend up to Verinag, and the Chenab Main up to the confluence of the river Chandra and the river Bhaga.

(5) The term "Eastern Rivers" means The Sutlej, The Beas and The Ravi taken together.

(6) The term "Western Rivers" means The Indus, The Jhelum and The Chenab taken together.

(7) The term "the Rivers" means all the rivers, The Sutlej, The Beas, The Ravi, The Indus, The Jhelum and The Chenab.

(8) The term "Connecting Lake" means any lake which receives water from, or yields water to, any of the Rivers; but any lake which occasionally and irregularly receives only the spill of any of the Rivers and returns only the whole or part of that spill is not a Connecting Lake.

Pakistan had to take a series of measures to manage the system after the treaty. India contributed Ponds Sterling 62.05 million, in ten equal instalments and IBRD arranged US$ 900 million for the required dams, link canals, barrages and tube-wells.

Following are some of the works constructed as a consequence of the treaty:

Dams

Description	Completed	Height (ft)	Live Storage Capacity (MAF)
Mangla	1967	380	5.34
Tarbella	1975	485	9.40

Link Canals

Description	Completed	Rivers	Length (miles)	Capacity (1000 Cusecs)
Trimmu-Sidhnai	1965	Chenab -Ravi	46	11.00
Sidhnai-Mailsi-Bahawal	1965	Ravi-Sutlej	62	10.10
Rasul-Qadirabad	1967	Jhelum - Chenab	30	19.00
Qadirabad-Balloki	1967	Chenab -Ravi	80	18.60
Balloki-Suleimanki II	1968	Ravi-Sutlej	54	18.50
Chashma-Jhelum	1970	Indus-Jhelum	63	21.70
Taunsa-Panjnad	1970	Indus-Chenab	38	12.00

Barrages

Description	Completed	River	Length (ft)	Capacity (1,000 cusec)
Sidhnai	1965	Ravi	712	150
Marala	1968	Chenab	4,475	1,100
Qadirabad	1967	Chenab	3,373	900
Rasul	1967	Jhelum	3,209	850
Chashma	1971	Indus	3,556	950
Mailsi (Siphon)	1965	Sutlej	1,601	429
Balloki (Remodelling)	1965	Ravi	1,646	225
Trimmu (Remodelling)	1965	Chenab	3,025	650

The Achilles' heel

To the Pakistani leadership, the treaty sounded a reasonable trade-off within the given constraints. But as the rivers flow through India before they enter into Pakistan and the treaty allowed India also to use the water of western rivers under certain conditions, this provision led to a number of disputes later on as India continued to construct storage structures over the western rivers, endangering the lifeline of Pakistan.

Article III of the treaty reads as follows:

ARTICLE III

Provisions Regarding Western Rivers

(1) Pakistan shall receive for unrestricted use all those waters of the Western Rivers which India is under obligation to let flow under the provisions of Paragraph (2).

(2) India shall be under an obligation to let flow all the waters of the Western Rivers, and shall not permit any interference with these waters, except for the following uses, restricted (except as provided in item (c)(ii) of Paragraph 5 of Annexure C) in the case of each of the rivers, The Indus, The Jhelum and The Chenab, to the drainage basin thereof:

(a) Domestic Use;

(b) Non-Consumptive Use;

(c) Agricultural Use, as set out in Annexure C; and

(d) Generation of hydro-electric power, as set out in Annexure D.

(3) Pakistan shall have the unrestricted use of all waters originating from sources other than the Eastern Rivers which are delivered by Pakistan into The Ravi or The Sutlej, and India shall not make use of these waters. Each Party agrees to establish such discharge observation stations and make such observations as may be considered necessary by the Commission for the determination of the component of water available for the use of Pakistan on account of the aforesaid deliveries by Pakistan.

(4) Except as provided in Annexures D and E, India shall not store any water of, or construct any storage works on, the Western Rivers.

The term non-consumptive use has been defined, by the treaty, as follows:

(11) The term "Non-Consumptive Use" means any control or use of water for navigation, floating of timber or other property, flood protection or flood control, fishing or fish culture, wild life or other like beneficial purposes, provided that, exclusive of seepage and evaporation of water incidental to the control or use, the water (undiminished in volume within the practical range of measurement) remains in, or is returned to, the same river or its Tributaries; but the term does not include Agricultural Use or use for the generation of hydro-electric power.

To be continued.

Learning from Structural Failures

Sohail Raza[2]

Pakistan has witnessed a number of structural failures in the not-too-distant a past.

Margala Towers, Islamabad, which collapsed during the Kashmir earthquake of 8th October, 2005

Many buildings, bridges, masts and playground equipment have undergone disasters that created a stir in the beginning but were erased from memories without any policy shifts for the future.

The primary causes of engineering disasters are usually considered to be:

- human factors, including both 'ethical' failure and accidents
- design flaws, some of which are also the result of unethical practices
- use of under specified or inferior materials
- poor workmanship and non-engineering practices
- complexity of codes and specifications leading to misinterpretation and misapplication
- unqualified belief in calculations and in specified extreme loads etc.
- poor training of field inspectors
- compressed design and/or construction time
- extreme conditions or environments, and, most commonly and importantly;
- a combinations of these reasons

In the aftermath of a failure, as feelings initially run high, the focus is on criminal aspects of the failure; learning technical lessons from failures is seldom the objective of the investigators.

[2] Chief Engineer, Lahore Ring Road Authority

Investigations are sometimes made by people not most qualified in the field, are sometimes biased and the findings of most are never published or publicly debated. Truth, therefore, is the first victim of such tragedies.

It is paramount that all investigations be headed by most respected professional of proven integrity and fullest benefit made from the technical lessons of each failure. Bureaucrats and politician's inspection teams may not deliver in this regard.

Chanawan Railway Bridge, 2nd July, 2015

A common feature for this type of investigations is that it is important to recognize that the information and statistics obtained from failure surveys are inherently incomplete and often biased. Information about errors and mistakes is difficult to obtain, since the actors involved often have a natural vested interest in concealing the facts. Furthermore, the data obtained in such surveys will usually not be representative since they are based on incomplete and voluntarily reported information. Still the experience gathered can be used to identify important technical and organizational flaws.

Collapse of factory building in *Sundar* Industrial *Estate Lahore, 4th Nov 2015*

One of the lessons learnt from investigating some major structural failures in Pakistan and abroad is that simpler things like gaps in communication have also caused major catastrophes. These communication gaps may include:

a. Poor communication between the various design professionals involved, e.g. engineers involved in conceptual design and those involved in the supervision of execution of works.
b. Poor communication between the fabricators and erectors.
c. Bad workmanship, which is often the result of failure to communicate the design decisions to the persons, involved in executing them.

Overturning of newly launched girders of bridge on Ghan Stream, Jhelum, 22nd May, 2016

Experts believe that arguably more can be learned from structural failures than from a study of successful structures. The proper appreciation of the causes of failure helps us to refocus our attention on the conceptual underpinnings of structural behaviour. In this way, the engineers have the opportunity to revisit its analytical models, which are essential for a successful design practice, and also evolve sound basis of the invaluable, albeit quasi-intuitive, part of design – the engineering judgment.

While the advent of digital computers opened a new era for scientists and engineers, the development of microcomputers with increasingly higher speed and decreasing prices has totally revolutionised the amount of power at the hands of a practising engineer. In their eagerness to increase the potential of their codes the software developers continued to bring the hardware industry even under greater pressure for further increasing the speed and memory.

The explosion of the computational power had a downside also: the younger graduates started placing a blind faith in numbers, focussing their microscopes on the individual leaf of a plant, at the cost of losing the sight of a bigger picture of the forest itself. A new generation of designers has now come of age which has

relegated the sensitive process of decision-making to machines.

Historically, much sound decision-making has inevitably been rooted in engineering judgment, which does not merely flow – at least not in its entirety – from a command of powerful computational tools.

> ***The explosion of the computational power had a downside also: the younger graduates started placing a blind faith in numbers, focussing their microscopes on the individual leaf of a plant, at the cost of losing the sight of the bigger picture of the forest itself. A new generation of designers has now come of age which has relegated the sensitive process of decision-making to machines.***

Even extensive design experience in an academic context can only provide limited perspectives in engineering judgment. Most fruitful lessons in engineering judgment are obtained from the case-histories of failures, which point invariably to examples of bad judgment; these provide guideposts for negotiating around the pitfalls in conceptual design. They also offer invaluable insight into the potential trip-wires in early attempts at innovative design and construction. In many cases, important new principles of engineering science may be brought out in the study of failure case studies.

"...a failed structure provides a counterexample to a hypothesis and shows us incontrovertibly what cannot be done, while a structure that stands without incident often conceals whatever lessons or caveats it might hold for the next generation of engineers."

~Henri Petroski

Sustainable Urbanisation

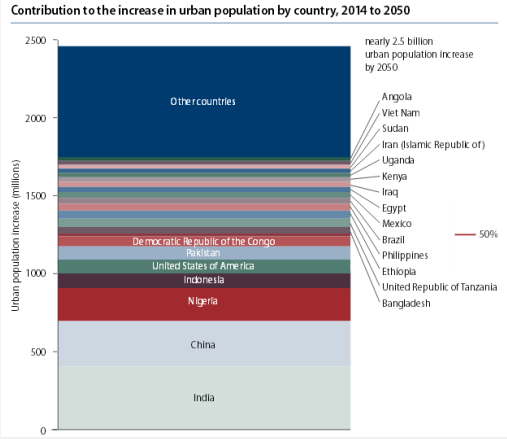
The Editorial Board

Pakistan does not officially declare its population and has even scantier and more unreliable estimates of urbanisation trends. Urbanisation has become a major challenge for city planners, around the world.

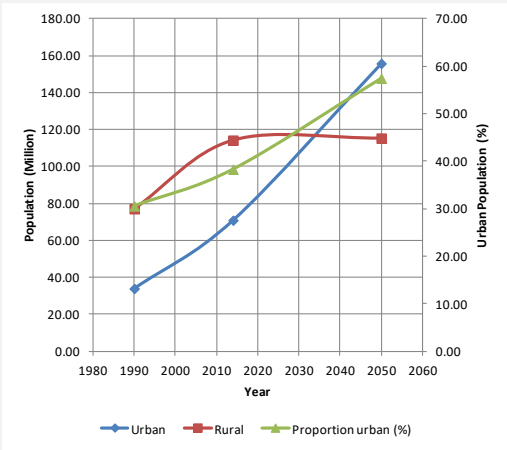
> ***"Managing urban areas has become one of the most important development challenges of the 21st century. Our success or failure in building sustainable cities will be a major factor in the success of the post-2015 UN development agenda"***
>
> ***John Wilmoth***
> ***Director of UN DESA's Population Division***

UN Habitat has reported that in the more advanced nations, urban population growth is next to stagnant (0.67 per cent on an annual average basis since 2010), which represents an additional six million or so every year. In Europe, the annual increase is only two million. By comparison, the aggregate annual population increase in six major developing-country cities – New Delhi and Mumbai (India), Dhaka (Bangladesh), Lagos (Nigeria), Kinshasa (Democratic Republic of Congo) and Karachi (Pakistan) – is higher than Europe's entire population.

Published data of UN reveals that Pakistan would rank sixth in the countries of the world contributing to the increase in urban population, from 2014 to 2050.



According to UN estimates, the percentage of Pakistan's population living in cities rose from 30.58% in 1990 to 38.30% in 2014 and in 2050 this percentage is expected to touch 57.45%.



Adopted from World Population Prospects, United Nations, 2014

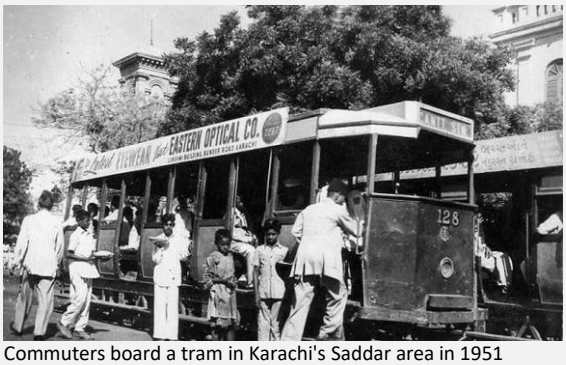
The Lahore of today is a far cry from that of 1960s, when standard and double-decker buses catered for the entire population in an extremely cost-effective manner and without any traffic jams.

This cannot be explained by an increase in population of the country, alone. The answer lies in the disproportionate increase in the urban populations, as this article hopes to demonstrate with the help of undeniable facts and figures.

Following figure is a nostalgic reminder of the city of Lahore, in the 1960s.

LOS double-decker crossing the GPO *chowk*, on the Mall Road [,Lahore]

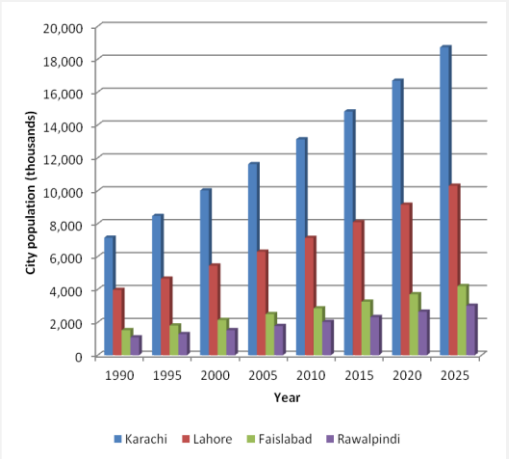
Karachi was no different.



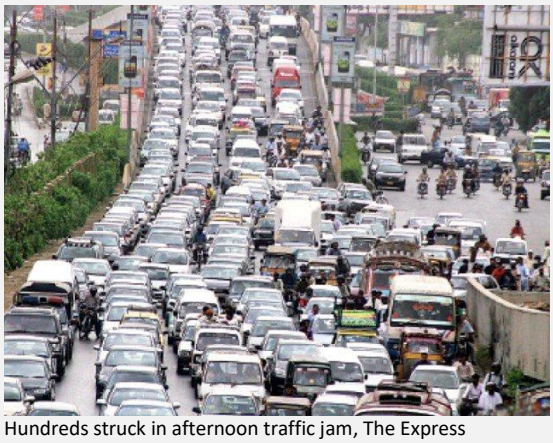
Commuters board a tram in Karachi's Saddar area in 1951

According to UN sources, in 1914, Karachi ranked twelfth in urban agglomerations of the world. This was a marked rise from its twenty-second rank in 1990.

City managers seem helpless as urban population soars. According to UN Habitat data, following is the population growth scenario of four cities of Pakistan:



Challenges posed by staggering pace of urbanisation are myriad.

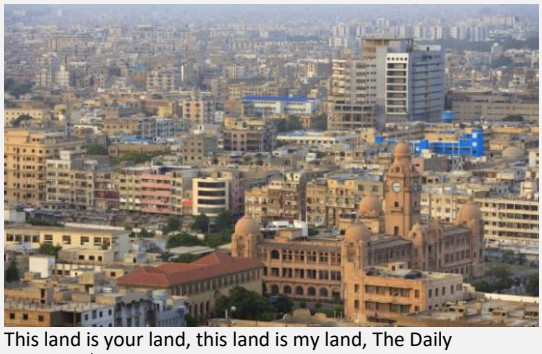


Hundreds struck in afternoon traffic jam, The Express Tribune, 31st July, 2012 [,Lahore]

These include failure of our most populous cities to cope with demand for housing, transportation, hospitals, schools, hygienic farm products – to name just a few. Increase in crime-rate has been a major result. It is well-known that urban crime is generically different from rural crime; the perpetrators of former are harder to trace.

Ironically, more the concentration of facilities in megacities, the worse the problems become. No wonder that the population gravitates to the megacities as the facilities are often added here at the cost of other cities. Lahore, alone, has around 7 public-sector and around 14 private-sector medical schools. The number of engineering schools is approximately 15. Similarly, the number of sizable public-sector hospitals is said to be around 16.

Serving many parts of the province, major whole-sale markets like Shah Alam, Akbari, Azam Cloth, Lohari and Moti are concentrated within the walled city. The top provincial government offices are located in Lahore. The logical conclusion is that Lahore is where the job opportunities are.



This land is your land, this land is my land, The Daily Dawn, 18th January, 2016. Photograph credit: Aliraza Khatri, [Karachi]

In the face of these problems, no serious attempt at a paradigm shift appears in sight.

It appears that skilled professional input in city planning is either incomplete or is not given full consideration in decision-making. The city of Lahore has been left to grow on its own as everyone has just watched it happen. Master plans do exist on paper but they do not reflect a long-term well thought-out professional strategy, addressing all technical and ecological issues. Residential districts of the city are suddenly declared open for commercial activities, apparently as a result of influence peddling by vested interests. Preparation of environmental impact assessment reports has been reduced to a farce.

The growth of Lahore has been haphazard, to say the least. City continued to growth towards north and when the space was exhausted, the growth started towards the south. Reported recent schemes have envisaged a mammoth expansion of the city, whereby the bounds of metropolis would touch those of the surrounding cities.

Karachi remains chronically short of drinking water.

The Herald, Tapping into Trouble. A man watches as a tanker is filled with water. Photo by Faisal Mujeeb [Karachi]

Despite tall claims by successive incumbents, the helpless citizens of Karachi are, by and large, at the mercy of tanker mafia.

Most attempts in Pakistan which could have left a positive effect on human settlement trends, failed to achieve this result. Two examples may be cited: concentration of industries at Sheikhupura and Chunian. While both these locations witnessed a huge influx of capital and many industries are functioning there now, none of these has undergone a fundamental social and cultural change. Proximity to Lahore sounded a death knoll on these objectives. Factory owners, managers

and engineers tend to rely on Lahore for major shopping, schooling of their children and some even live at Lahore and daily commute to their workplaces.

Planning for cities needs to have precisely defined long-term, medium-term and short-term objectives. The guidelines, in this respect, must be prepared by teams of experts in a transparent manner. Influence-peddling by vested interests needs to be carefully guarded against. A national debate may be allowed to precede the finalisation of the criteria.

While no simple solutions may exist, much can be learnt from experiences made elsewhere in the world. It is important to realise that cities are engines of progress. Countries cannot hope to progress and develop without urbanisation. What is required is sustainable urbanisation – an urbanisation that does not harm the environment.

Given the complexities of the issues at hand, it is recommended that major cities of Pakistan shall forthwith put together teams spearheaded by competent professionals of all related planning and engineering fields, who should be given an opportunity to work without any undue influence.

It is also about time that the provincial government too shall take a lead in this regard and develop policies conducive to appropriate human settlement trends.

Transportation Geometrics and Signage

Dr Riaz Akhtar Khan[3]

The presence of flawed transportation geometrics and signage in the capital of the province of Punjab, Lahore, suggests either utmost negligence or sheer incompetence, on the part of those officials who make decisions or those who implement them.

A road-user cannot steer his or her way to the required destination with the help of signage. There is so much confusion at many locations that unless someone frequently travels through them, the probability of turning in the correct direction and taking the right road is extremely low. Thokar Niaz Beg is one case in point.

As the medians and barriers have now been made to run uninterrupted for very long distances, it has become all the important for the road-user to know, well in time, where to expect a turn.

Other examples may be found at the canal road underpasses. The standard protocol of lettering size, lettering face, height of sign and distance between the information sign and the underpass has not been adopted.

The road and abutment edges have not been identified using standard markings, as illustrated by the figure below.

Advance low-clearance (W-18) and low-clearance (W-19) signs have not been provided

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in conjunction with each other, at correct locations, and in the correct size and lettering.

The standard signs contrast with the actually installed signs. The following figure shows an advance low-clearance sign installed on the structure of the underpass itself.

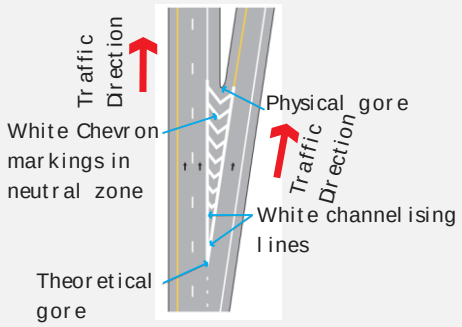
The following example shows a missing low-clearance sign on the structure:

These above figures selected examples only and do not imply that the signage elsewhere is correct.

The Askari Underpass portrays yet another picture. Although the clearance is 5.3 m, the advance low-clearance sign has been installed over a pole too close to the structure to be meaningful, while the low-clearance sign is missing altogether.

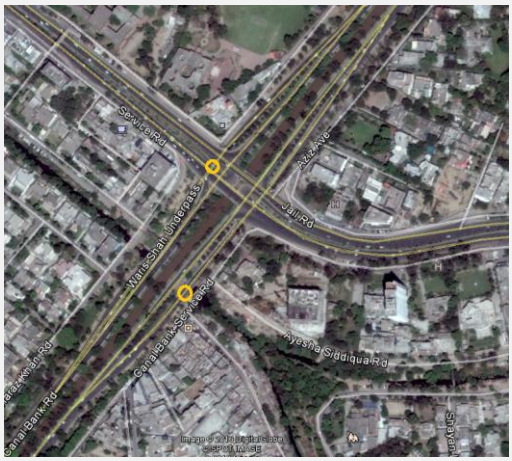
All of this can lead to an accident if an educated road-user correctly interprets the markings or draws a conclusion in the absence of a marking.

Many signs seem to have been used as a decorative element. A case in point is chevron lines. On many locations, on city roads as well as highways, the orientation of the chevrons signs is opposite to what it should be. The following figure illustrates the relationship of these signs with direction of traffic flow.



There is a lack of predictability in the lane on which an underpass is located on the Canal Bank Road. As a rule, an underpass is located on the fastest lane, which in Pakistan would be the right-most lane. Two underpasses on the Canal Bank Road occur on the left-most lane. These are: Jail Road and Ferozepur Road underpasses.

The following figure shows an image of the Jail Road Underpass.



There has been a recent attempt to correct the error on Ferozepur Road Underpass, but the solution is imperfect and leaves much to be desired.

The intersection between Ali-Zeb Rd. and Main Boulevard, Gulberg, Lahore, close to the Kalma Chowk Underpass, has flawed geometrics.

The absence of a storage lane and the shortage of distance to the underpass, are factors that endanger the motorist while he or she enters the Main Boulevard from Ali Zeb Road. Further, it has dangerously small weaving distance before entry to the underpass approach.

The geometrics of overhead bridge at Qainchi, connecting Ferozepur Road with Walton Road is flawed on account of having an extremely small radius on a turn involving a very large angular change in direction. Many accidents have already taken place due to this feature of the bridge. Following figure illustrates the point.

Missing illumination at critical locations is another point that merits attention.

The author feels that this fair comment would help identify some of the deficiencies in the geometrics and signage of the transportation system.

In a properly designed traffic control system, markings have specific functions. Pavement markings guide the movement of traffic and promote safety on The highway. In some cases, they are used to supplement the messages of other Traffic control devices. In other cases, markings are the only way to convey a Message without distracting the driver.

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