Engineering News

A Quarterly Journal of the Pakistan Engineering Congress

Vol: 43 April - June 2007 No: 2

PAKISTAN ENGINEERING CONGRESS
THE EXECUTIVE COUNCIL FOR THE 71TH SESSION

PRESIDENT
Engr. Husnain Ahmad

VICE PRESIDENTS

1	Engr. R. K. Anver	8	Engr. Ch. Muhammad Rashid Khan
2	Engr. Dr. Bagh Ali Shahid	9	Engr. Pir Muhammad Jamil Shah
3	Engr. Ch. Muhammad Arif	10	Engr. Shehzad Jamil Sheikh
4	Engr. Shaukat Ali Shaheen	11	Engr. S. M. A. Zaidi
5	Prof. Dr. Ing. Syed Ali Rizwan	12	Engr. Akhtar Abbas Khawaja
6	Engr. Ch. Ghulam Hussain	13	Engr. Faqir Ahmad Paracha
7	Engr. Dr. Izhar ul Haq		

OFFICE BEARERS

1	Engr. Ch. Ghulam Hussain	. . .	*Secretary*
2	Engr. Iftikhar Ahmad	. . .	*Treasurer*
3	Engr. S. M. A. Zaidi	. . .	*Business Manager*
4	Engr. Ahmad Nadeem	. . .	*Joint Secretary*
5	Engr. Muhammad Sarfraz Butt	. . .	*Publicity Secretary*

EXECUTIVE COUNCIL MEMBERS

1	Engr. Abdul Sattar Khan Lillah	18	Engr. Prof. Mian Zia ud Din
2	Engr. Ahmad Nadeem	19	Engr. Rana M. Aslam Chohan
3	Engr. Anwar Ahmad	20	Engr. Rana M. Saeed Ahmad Khan
4	Engr. Atiq ur Rehman	21	Engr. Sajjad Hussain Nasim
5	Engr. Capt. (R) M. Qadir Khan	22	Engr. Shabbir Ahmad Qureshi
6	Engr. Ch. Aftab Ahmad Khan	23	Engr. Syed Anwar ul Hassan
7	Engr. Ch. Foad Hussain	24	Engr. Syed Saleem Akhtar
8	Engr. Ch. Iftikhar ul Haq	25	Engr. Tahir Anjum Qureshi
9	Engr. Ijaz Ahmad Cheema	26	Engr. Zaffar Ullah Khan
10	Engr. Khalid Javed	27	Engr. Syed Abdul Qadir Shah
11	Engr. Liaqat Hussain	28	Engr. Shahid Ahmad
12	Engr. Muhammad Ibrahim Malik	29	Engr. Tariq Iqbal Mian
13	Engr. Muhammad Saeed	30	Engr. Faisal Shehzad
14	Engr. Muhammad Sarfraz Butt	31	Engr. Iftikhar Ahmad
15	Engr. Najam Waheed	32	Engr. Malik Ata ur Rehman
16	Engr. Naveed Alam	33	Engr. Taufique Ahmad
17	Engr. Nayyar Saeed		

COVER PHOTO

Taunsa Barrage Emergency Rehabilitation and Modernization Project
Dismantling of Main Barrage Floor

48th YEAR OF PUBLICATION

Engineering News

A Quarterly Journal of the Pakistan Engineering Congress
Vol. 43 April - June 2007 No. 2

ON OTHER PAGES

IN THIS ISSUE

NEWS

TECHNICAL VIEWS

PUBLISHED BY
Pakistan Engineering Congress
Ph: 5784237-5784238 Fax: 5784236

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.

WORLD ENVIRONMENT DAY

As one of its objectives of promoting Science and Engineering and as usual Pakistan Engineering Congress observed the World Environmental Day at its Auditorium on Saturday, the 2nd June 2007. The theme of the World Environmental Day this year was **"Climate Change".**

The Chief Guest Dr. Anjum Amjad, Minister of Environment Protection Punjab gave highly illuminating scenario of the 'Global Warming' issue and its impact on Pakistan. In her eloquent treatise, she dwelt at length on the causes of degradation of environment leading to adverse climate change in all fields of human life, may it be due to fossil fuel gaseous exhausts on Roads, Industry, on energy plants or excessive denudation of earth by deforestation or over grazing of hilly tracts etc. She recounted health hazards to humanity as a result of Environmental degradation in the context of global warming and warned of the stark naked consequences unless curative remedial steps are taken anon to thwart such an untoward trend. She quoted example of developed countries seized with this global problem who already conscious of this menace were afoot on combation of the issue.

Earlier Engr. Husnain Ahmad, President Pakistan Engineering Congress in his 'welcome' address gave a comprehensive picture of the issue facing the entire world with far reaching repercussions for Afro-Asian Countries.

He drew attention of the audience that the World at large & the emerging economics of countries like Pakistan are faced with the ever increasing global warming i.e. raising temperature due to vast emissions being generated on the Roads, Factories, Homes and Offices of the industrialized as well as the rapidly industrializing economics such as Brazil, China, India which overwhelmingly depend on burning of Fossil Fuels for meeting with the ever increasing energy demands.

The global Rise in average global temperature by the end of the century, he continued, will range between 1.8 to 4.0 (or even by more than 5 degrees centigrade). That shall result in minimum loss of 5 percent of GDP activity. Studies have revealed that if Greenlands Ice Cap (which is presently melting where it is in contact with surrounding oceans) entirely melts, it will increase the Sea level by 7 meters. The UN Intergovernmental Panel on Climate Change (IPCC) has predicted that Global Warming will cause widespread drought, unprecedented floods, and hunger in Asian Countries. Most hard hit will be China, India, Pakistan Vietnam, Thailand, and Bangladesh. Flooding in Coastal areas due to oceans rise will displace around 60 million people in South Asia comprising Pakistan, India, Sri Lanka, Bangladesh, Myanamar. 250 million people will be displaced in China alone.

He foresaw that Thailand with 3.6 million Farmer Families is presently earning valuable Foreign Exchange through export of 7.5 million tons of Rice annually. It will not even be able to feed its people what to talk of exporting the staple food. Mass migration of population from the Coastal areas to urban centres will give another crippling blow.

Pakistan, he went on to say, is an emerging economy and is most vulnerable to Climate Change especially because its economy is overwhelmingly dependent on Agriculture. Agriculture not only feeds the teeming millions but is also the main source of export of crops such as cotton, rice etc. Agriculture is also the backbone of Textile and Garments industry fetching valuable Foreign Exchange.

Paksitan, he said, is entirely dependent on its water supply on dry land glaciers, the World's largest Reservoirs of Fresh Water outside the Polar Caps. A report by intergovernmental Panel of experts shows that the Himalayan glaciers are receding at an alarming pace and may disappear altogether if the rise in temperatures is not contained. The receding Arctic Sea Ice Cap is reducing the habitat of vulnerable species and Jeopardising Socio-Cultural life of its habitants. Weather changes resulting from "Climate Change" will drastically affect Water Supply the World over. It will have disastrous effect on Africa in the shape of droughts,

desertification and food shortages.

Climate Change will cause irregular rainfall brining in its wake devastating floods resulting in destruction of infrastructure of Billions of Rupees as well as loss of human life, livestock and standing crops.

He recommended putting of brakes on indiscreet and aimless burning of Fossil Fuels and urged on:-.

- Switching on to alternate and renewable sources of energy i.e. Wind-Power, Bio-energy & geo-thermal energy and even nuclear energy;
- Massive campaign to plant trees. They can slow Climate Change by absorbing carbon dioxide;
- Collective and decisive political will and a Financial & Civil partnership to slow down greenhouse effects / Climate Change.
- To embark on policies to protect the dry lands from turning into deserts.
- Destruction & safe disposal of dangerous goods, garbage& waste materials. Banning of use of plastic bags & such like items.
- Holding Seminars, Workshops, Marches, meetings for creating awareness in the Public about Environmental issues as well as printing of Articles, Boks on the relevant issues.

Seven papers on the theme of the Seminar were presented as under:-

1. Ms. Safia Shafiq spoke on the topic of:-
   "Engineering Options for Managing and Mitigating Climate Changes".

2. Engr. Rehmat Ullah Jelani elaborated on the topic of:-
   "An Over-View of Glacier Depletion in Tibetan Plateau"
3. Dr. Qamar-uz-Zaman Chaudhry treated the audience on:-
   "Climate Change & Sustainable Development"

4. Dr. Rakhshan Roohi deliberated on:-
   "Glaciers – The Barometer of Climate Change"

5. Dr. Amin U. Khan discussed on:-
   "Climate Change & The Tree Limit Rise & Fall-An Optimistic Scenario For European Mountains & Pessimistic Scenario For Himalyas"

6. Engr. Shafqat Masood gave a discourse on the topic of:
   "Adapting to Risks of Climate Change"

7. Mr. Shaukat Ali Awan enlightened the audience on:-
   ""Impact of Temperatures Gradient with Time & its Variation with Reference to Change of State"-

After the presentation, the audience comprising about 300 members of Engineering Congress / Faculty Members of Universities / Students and the Print & Electronic Media asked numerous questions about the steps being taken by the Civil Society / Government Departments to avoid & minimize the devastating socio-economic impact by the Change in Climate.

President Pakistan Engineering Congress presented shields / certificates to the speakers. The event was followed by a generous lunch hosted by Pakistan Engineering Congress.

At the Dais
Engr. Husnain Ahmad
President
Pakistan Engineering Congress
Engr. Tariq Hameed,
Chairman WAPDA
and
Engr. Ch. Ghulam Hussain
Secretary
Pakistan Engineering Congress

Engr. Ch. Ghulam Hussain
Secretary
Pakistan Engineering Congress
Presenting Key Note Address

Section of the Audience

WORLD WATER DAY OBSERVED IN MARCH 2007

"Think Tanks" took cognizance of the rapidly depleting water resources on earth. They foresaw that future wars would mainly be fought on the sharing of waters more so when it has been often brought out in the Media that with the astronomical evolution of communications, the world has by and large been virtually reduced to a global village and such a possibility would not be a lunatic's cry. It was with this sort of trauma that the comity of Nations rose to the occasion and in 1992 during the "United Nations Conference on Environment and Development (UNCED)" in Rio de Janeiro took initiative for observance of World Water Day every year starting on 22nd March of 1993.

Further, during its 58th Session UNO declared the period from 2005-2015 as the international decade for Action "Water for Life". As of World Water Day – 22nd March 2005 it marks the start of it. The Seminars and Symposia on World Water Day during **water for life decade 2005-2015** will boost the chances of achieving international water goals including those in U.N. Millennium declaration for tapping all available water resources and conserving water above the surface and underground.

Think Tanks earlier failed to pay heed to Almighty Allah's revealing in the Holy Quran where He says that He created everything from water " وَ جَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيَّ ط اَفَلَا يُؤْمِنُوْنَ ○ " and what an eye opening testimony that burgeoning population of humans, animals, birds, forests, trees, plants and all kinds of surface and water creatures is seen throbbing and humming at the river banks, water channels, underground reservoirs where water is available. 'Water is life' is also manifest from non-existence of life in great deserts of the world.

This year with the continued co-sponsorship of WAPDA, the World Water Day was observed in March, 2007. The theme of the year was with reference to **scarcity of water**. Eight Technical Papers aimed at discussing problems cropping up in the context of availability of surface water, groundwater or waste water, their frugal usage, conservation and ways and means to be adopted for overcoming of scarcity through management and technical measures were presented by elite Engineers and Scientists. A hearty discussion ensued on the conclusion of each Paper.

A Panel of Experts formulated valuable recommendations to be forwarded to the Government for consideration as a result of these discussions.

In his concluding remarks of the event Engr. Muhammad Mushtaq Chaudhry, Member (Water) WAPDA observed that it was well established fact that water is a finite natural resource providing basis for development of the civilization, agriculture, industrial and municipal aspects of life. He stressed that all of us have to be very conscious for its proper utilization and management on sustainable basis and take care of future generations.

He recounted that Engineers and Scientists presented 8 papers relating to water i.e., its surface availability and conservation; its management / mining and use of high efficiency techniques, environmental hazards in the context of water and their solutions etc. to overcome the scarcity of this rare commodity in which very life on earth is shrined.

He pointed out that in the First presentation "Water Scarcity and WAPDA Vision – 2025" by Engr. Muhammad Mushtaq Chaudhry and Dr. Allah Baksh Sufi, the authors deliberated and highlighted the urgent need for the development of storage reservoirs as envisaged in WAPDA Vision 2025. The country has surface water flows of 21 MAF available for immediate storage development excluding Mangla Raising Project. A significant part of this storage will compensate the storage capacity loss through sedimentation. At this stage excessive

groundwater pumpage is creating secondary salinity and sodicity in the fertile lands of the country for which sustainable groundwater management under proper regulatory framework has been advocated. The authors have indicated that there will be a gap of about 20 MAF between supply and demand by the year 2025 which could be met through the development of Vision Projects. Apart from implementation of Vision Projects, the need for high irrigation efficiency systems has been stressed. The need for the involvement of all stakeholders including women participation regarding water management and its governance has also been highlighted.

The second paper was "Combating Water Scarcity" by Dr. Izhar ul Haq. The author expressed that country is likely to face serious water, food and power storages after 2010 and recommended immediate construction of a large reservoir and hydropower project. Small storage dams and hydropower stations should be built where feasible. The author also endorsed conservation of hill torrents, modern irrigation techniques and groundwater regulation.

The third paper on "Groundwater in Coping with Scarcity" by Dr. Muhammad Nawaz Bhutta discussed the groundwater availability, its mining and water quality issues regarding the pollution of lands and aquifers especially near the municipalities and lack of coordination between various organizations responsible for groundwater management. The author recommended the need for groundwater regulation, rainfall harvesting for additional recharge, supplemental irrigation supplies for reducing the dependence on groundwater extraction.

The fourth paper "Coping with Water Scarcity and Indus Waters Treaty Vision" by Dr. Usman-e-Ghani discussed repercussions of the allocation of three Eastern Rivers of the Indus Basin viz., the Sutlej, the Beas and the Ravi to India through this treaty thus diverting water supplies of Pakistan earst while being made from Modhopur Head Works on the Ravi and Ferozepur on the Sutlej to India and rendering vast areas of the District of Lahore and Bahawalpur state absolutely dry and arid. Water scarcity so caused had long lasting adverse effects on the economy of Pakistan.

The fifth paper on "Groundwater Scarcity of the Water Resources" by Shafqat Masood expressed that Pakistan has been included in the list of 17 countries facing absolute water scarcity and would face serous shortfalls by the year 2025 and suggested awareness among the stakeholders regarding water conservation, groundwater regulation, rain water harvesting, hill torrent management and adoption of drip and sprinkler irrigation techniques.

The sixth paper was on "Waste Water Re-use for Crop Production An option for Sustainable Agriculture Under Water Scarce Environment" by M/s. Sarfraz Munir, Abdul Hakeem and Aamir Naseer. The authors have presented the results of the study that waste water is alternative to the scarce fresh water but have cautioned the health risk under direct use and proposed conjunctive use with canal water.

The seventh paper "Efficient Irrigation Techniques to cope with Water Scarcity" by Mr. Muhammad Yasin discussed that Pakistan is a water stressed country and suggested to increase productivity of per unit of water through innovative, improved and efficient irrigation techniques advocated by earlier speakers.

The eighth paper was "Groundwater Sustainability to Cope with Water Scarcity" by Mr. M. Arshad and Jehanzeb Masood regarding use of Inverse Modelling for groundwater recharge. The model discussed the assessment of net groundwater recharge in selected command area with the Rechna Doab for the Upper Gogera Branch and showed that the aquifer had depleted over the period, is agreeable that numerical models are good tool for assessing the recharge of groundwater for proper management of precious resource and there is need to

assess contribution of groundwater recharge in the whole Indus basin for efficient management of groundwater for its long term sustainability.

He thanked all the authors for their technical contributions based on which valuable recommendations had been framed. The recommendations based on this forum, he continued; would help policy makers in combating water scarcity in the country for its sustainability. WAPDA and Pakistan Engineering Congress, he hoped, would continue to celebrate this important occasion which they started since last few years in recognition of its important role for the development of water resources which is the primary need of the agro-socio-economic uplift of the nation.

Earlier in his address of welcome to the Chief guest of the occasion Engr. Tariq Hameed, Chairman WAPDA, President Pakistan Engineering Congress quoted several verses from the Holy Quran in the context of the creation of water by Almighty Allah. He remarked that enough water was available in Pakistan both in the shape of run of the rivers and underground reserves. He showed grave concern that in Pakistan 40 MAF was being allowed to run untapped to the seas during rainy season which left agricultural lands high and dry during the months of October – March. Non construction of Mega Multipurpose dams ostensibly not only reduced the most needed food production but also has become traumatic dilemma in the wake of short supply of pollution – free hydropower energy most necessary for the development of the country.

He vehemently stressed that scarcity of water could only be overcome if the following actions were taken in hand in earnest.

- Big Reservoirs for proper storage and conservation of water are constructed.
- Balance between availability and demand of water is maintained.
- For assured supplies at the proper time water is conserved and stored.
- Degradation of "Ground Water" and "Surface Water" is avoided.
- To avoid depletion of Ground Water Resources proper planning, legal frameworks and governance of Ground Water usage is observed.
- Economical domestic use of Water through re-cycling is introduced.
- Switching from High Delta Crops to crops requiring less water input is resorted to.

Engr. Tariq Hameed, Chairman WAPDA in his address as Chief Guest and Ch. Ghulam Hussain, Secretary Pakistan Engineering Congress in his key note address both were too eloquent in expressing their concern over the Water Scarcity which is looming large and posing grave threats to the posterity if the issue continues to be ignored as has been done so far and construction of large dams is not taken in hand immediately with a fervent zeal of patriotism, service to the nation and a secure future for the coming generations.

PAKISTAN ENGINEERING CONGRESS
DELEGATES VISIT PAK ARAB FERTILIZER FACTORY AND TAUNSA BARRAGE REHABILITATION AND MODERINZATION PROJECT

Pakistan Engineering Congress delegates visited Pak Arab Fertilizer Factory Piran Ghaib (Multan) on March 24, 2007 and Taunsa Barrage Emergency Rehabilitation and Modernization works on the following day on March 25, 2007.

The delegation which comprised the following 21 members left Congress Head Office at 08:30 hours and reached the fertilizer factory at 14:00 hours. The delegation was received by the Senior Management and served a well deserved refreshing tea after a long journey. Thereafter the members were taken around various factory units right from intake of natural gas of Sui fields through to end product of urea fertilizer and its packing process. The members took deep interest in all the process and appreciated the role of the factory in the national development of Agri produce. Beside, the factory is providing livelihood to an appreciable number of families.

The members were told that founded by the Punjab Industrial Development Corporation in the year 1950, the factory is now running under the Management of the Privatized Company since 1973.

After the visit to the Factory Units the members were treated to a generous lunch by the Factory Management. The list of the delegates who visited the factory is as under:-

1. Engr. Husnain Ahmad, President
2. Engr. S.M.A. Zaidi
3. Engr. Khalid Javed
4. Engr. Ijaz Ahmad Cheema
5. Engr. Nasir
6. Engr. Pir Muhammad Jamil Shah
7. Engr. Najam Waheed
8. Engr. Naveed Alam
9. Engr. Iftikhar Ahmad
10. Engr. Mazhar Hussain
11. Engr. Akhtar Abbas Khawaja
12. Engr. Saeed A Choudhry
13. Engr. Foad Nasir
14. Engr. Abdul Rahim
15. Engr. Usman Tehsin Shah
16. Engr. Faisal Shehzad
17. Engr. Usman-e-Ghani
18. Engr. Usman Haider Shah
19. Engr.K.B. Nasir
20. Engr. Anwar Qaseem Qureshi
21. Engr. Naeem Akhtar

The delegation left the factory at 17:00 hours and stayed for the night at Holiday Inn Hotel Multan.

On 25th March 2007, after breakfast the delegates left Holiday Day Inn Hotel Multan at 08:00 hours for Taunsa Barrage Emergency Rehabilitation and Modernization Project reaching there at 10:20 hours.

The delegation was received by Project Manager of the Project along with the Chief Resident Engineer and other senior officers.

The delegation was served high tea at 11:00 hours. Then a comprehensive presentation about the construction of Barrage in 1958, the canals that took off, the areas these served, the ever deteriorating health of the structures, the remedial measures taken from time to time, various Technical Reports by the Panel of Experts and the final decision of the Government of the Punjab to undertake Emergency Rehabilitation and Modernization of the Barrage was given by the Project Management. The cost of construction is being sponsored by the World Bank and JICA each. A consortium of Consultants comprising National

development Consultants (NDC), Lead Firm and NESPAK & ATKINS for the Detailed Design and Construction Supervision have since been engages and after preparation of Detailed Design are now acting as the Engineer for construction phase.

Some salient features of the presentation about the Project given by the Project Management is contained as below:

Year of Const	Flood Disch Cap. (000, Cs)	Length b/w Abutt. (feet)	Clear Water way (feet)	Off-takes								
				Irrigation Canals						Link Canal		
				Name	Design Disch. Cap. (000, Cs)	Length (Canal Miles)			CCA (000, Acres)	Name	Design Disch. Cap. (000, Cs)	Length (Canal Miles)
						Main	Branches & Distys	Total				
1958	1000	4346	3860	Muzafar-Garh canal	8.3	74.2	978	1053	970	Taunsa punjnad link canal	12	38
				D.G. Khan canal	8.9 /14.2	69.0	1049	1118	1.384			

Taunsa Barrage more than a conventional Barrage provides the following services:-

1. Irrigation facilities to areas in Muzaffargarh, DG Khan and Rajanpur Districts (2.354 million acres)
2. Covering inundation canal systems into weir regulated irrigation system.
3. Accommodates rail road crossing for the direct rail link between Jot Adu on the left bank and Kashmore on the right bank of river Indus thus providing a continuous rail road from Attock to Kotri on the right (western) bank of Indus river.
4. Accommodates a Class 70/AA loading Arterial Road Bridge.
5. Accommodates a 16" dia high pressure pipeline owned by PARCO for conveying petroleum fels from Karachi to the up country storage at Mahmood Kot terminal.
6. Accommodates a 16" dia pressure (12000 psi) gas pipe lines owned by Sui Northern Pipe Lines Ltd (SNGPL) providing up country link for Dhodak gas field.
7. Facilitate a telephone line and EHV transmission line crossings.
8. Feeds the TP Link canal to supplement the supplies required at Panjnad headworks for Panjnad and Abbasia canal systems.

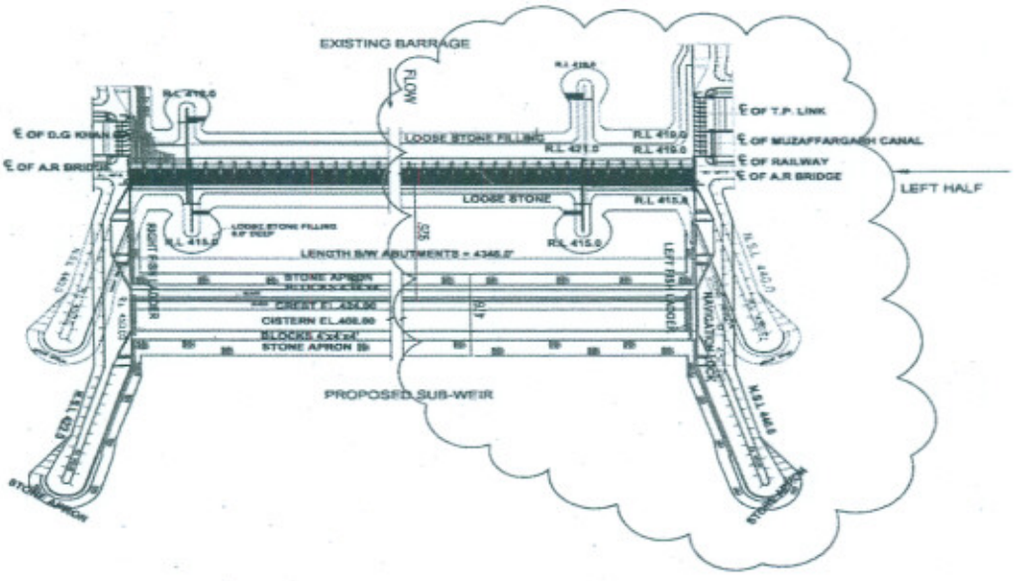
The objectives of Taunsa Barrage Rehabilitation and Modernization Project are to remodel the barrage complex to make it safe against the following:-

- Retrogression of levels on the downstream
- To revive the design head across of 26.50 ft.
- Meeting design Deficiencies/Improvement to stilling basin.
- Fissured concrete of downstream floor cavities/loose contact below the floor.
- Addressing silt entry problem of DG Khan
- Improving drainage of the backfill of d/s flared out walls.
- Improving gates and hoist system.

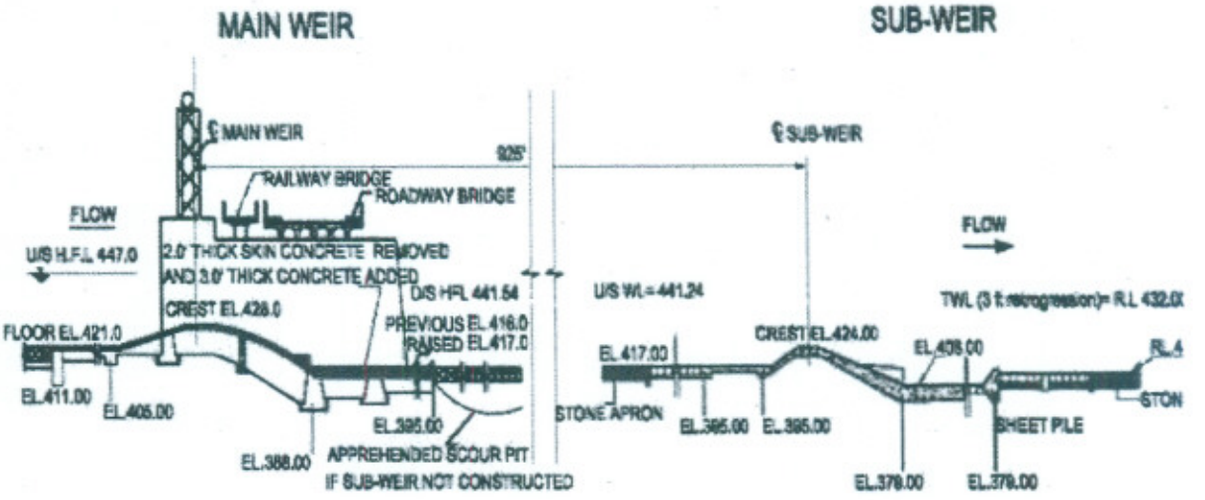
PROBLEMS & PROPOSED REMEDIAL MEASURES

Problems	Remedial Measures
Retrogression of levels on the downstream of barrage and consequential issues.	Construction of a subsidiary weir to raise tail water levels.
Repeated damages to stilling basin appurtenances including rupture of skin concrete and leaking joints of mass concrete.	Grouting of leaking joints and removal of weak concrete from top of existing d/s floor and laying of thick new concrete of 4000 psi strength.
Sedimentation problems in DG Khan canal	Construction of silt excluder and raising of crest of head regulator of D.G Khan canal by 1 ft.
Repeated subsidence of the backfill of left and right flared out walls on the downstream.	Provision of a proper filter and pressure release pipes behind the flared out walls.
Choking of about 80% of pressure pipes and mal-functioning of the remaining20%	Provision of vibrating wire (electronic) piezometers.
Operational problems of gates and hoists	Replacement of 11 gates of under sluices Modification of remaining 53 gates of main weir Replacement of hoisting system of all the barrage gate. Replacement of 7 gates of TP Link and 7 gates of DG Khan canals along with modification of 5 gates of Muzaffargarh canal. Automation with central control mechanism.

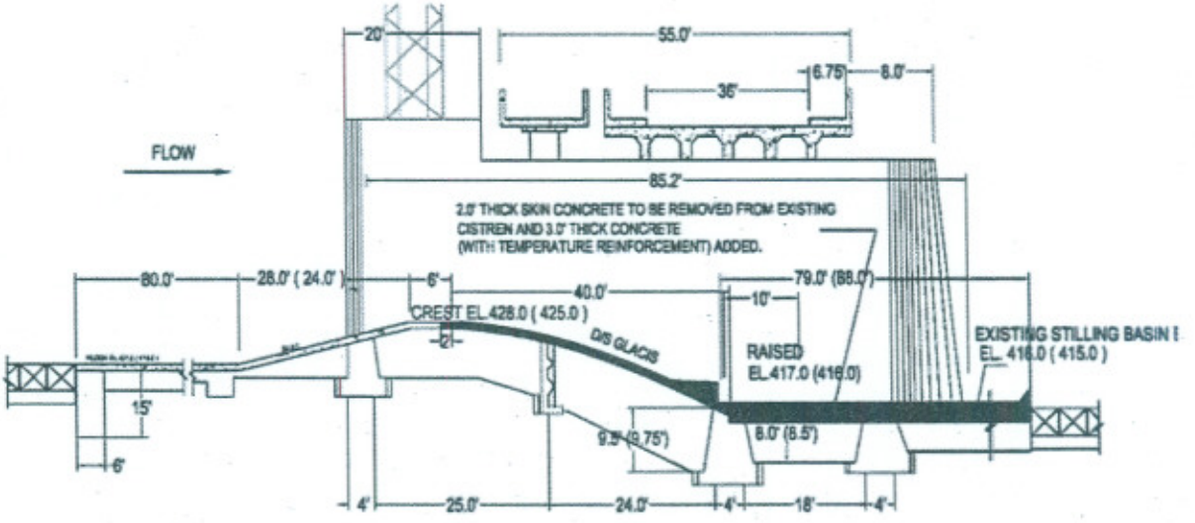
PERMANENT WORKS PLAN



PERMANENT WORKS (X-SECTION)



PERMANENT WORKS PLAN



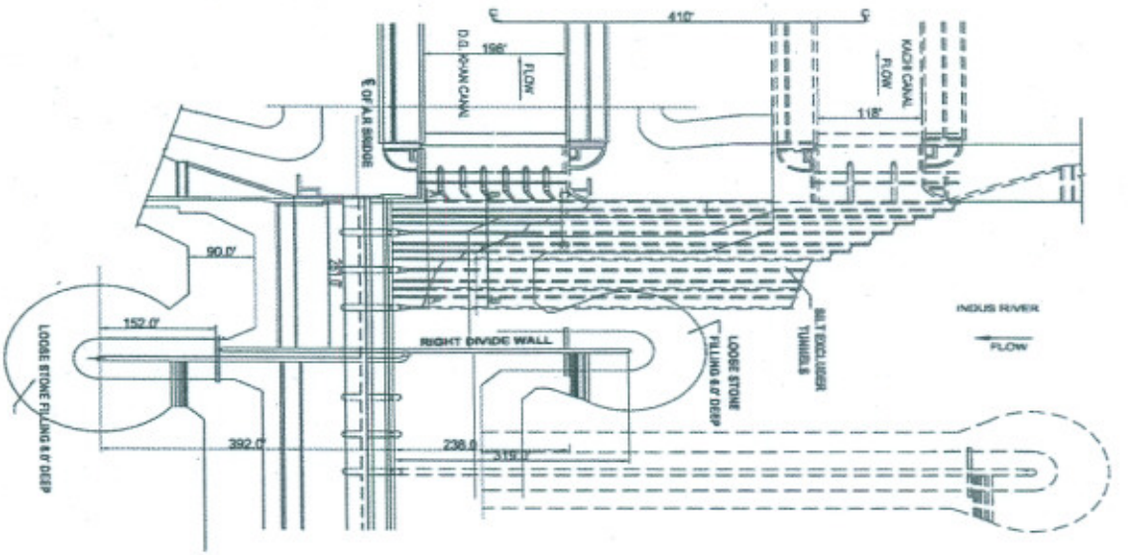
GROUTING

- **GENERAL**

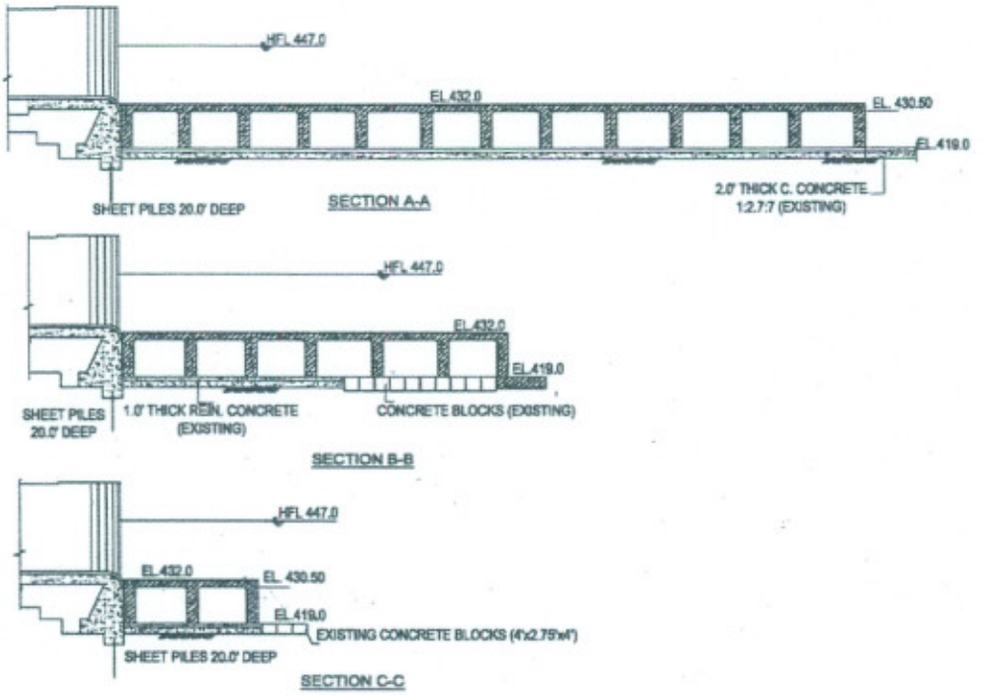
  - On the basis of gravity, resistivity survey and confirmatory drilling results, it was concluded that quality of mass concrete in stilling basin is poor. Voids, cavities in various forms at the interface of the mass concrete and the base alluvium and factures / fissures and leaky joints in the mass concrete were indicated.

- **SCOPE OF GROUTING WORKS**
  - Consolidation grouting of existing mass concrete in the d/s floor
  - Filling of cavities under the existing d/s concrete floor at the interface with base alluvium (Contact grouting/fill grouting)
  - Grouting of drainage trenches and perforated drain pipes under the new concrete overlay
- **GROUT COMPOSITION**
  - For consolidation grouting water cement mixture in the ratio of 2:1 was used. A minor quantity of hydrated bentonite was added for minimizing shrinkage of grout
  - For filling of cavities, 30% fine river sand, 60-65% clayey silt passing 200 sieve, 10% cement (OPC), 1.5% hydrated bentonite and water perform a thick grout was used
  - Pressure applied for grouting varied from 5-10 psi in general. However in mass concrete rejection pressure up to 25 psi was used
- **GROUT UPTAKE**
  - Varied from hole to hole and bay to bay

SILT EXCLUDER IN RIGHT POCKET OF TAUNSA BARRAGE



SILT EXCLUDER IN RIGHT POCKET



QUALITY CONTROL

- Specifications.
- Quality Control Manual.
- Monitoring, Inspection and Testing.
- Inspection, Measuring and Testing Equipment.
- Testing and Test Results.
- Non-conformance Reports and Actions
- Quality Control Records.
- Internal Quality Audit.

CONSTRUCTION CONTRACTS

➢ **World Bank Funded Contracts**

- **Contract ICB-01** – Sub Weir, Downstream Floor of Barrage Instrumentation (M/s Descon-CGGC-JV)
- **Contract ICB-02** – Gates of Bay # 8, 31 to 65 DG Khan, TP Link and Muzaffargarh Canals (M/s CCC Chins)

➢ **JICA Funded Contracts**

- **CP-01** – Gates of Bay # 1 to 7 and 9 to 30 M/s Kurimoto-Taisei JV)
- **CP-02** – Supply of Bulkhead Gates (M/s Marubeni)
- **CP-03** – Supply of two tug boats and three working boats (M/s Marubeni)
- **CP-04** – Supply of one 60 ton truck crane (M/s Mitsubishi)

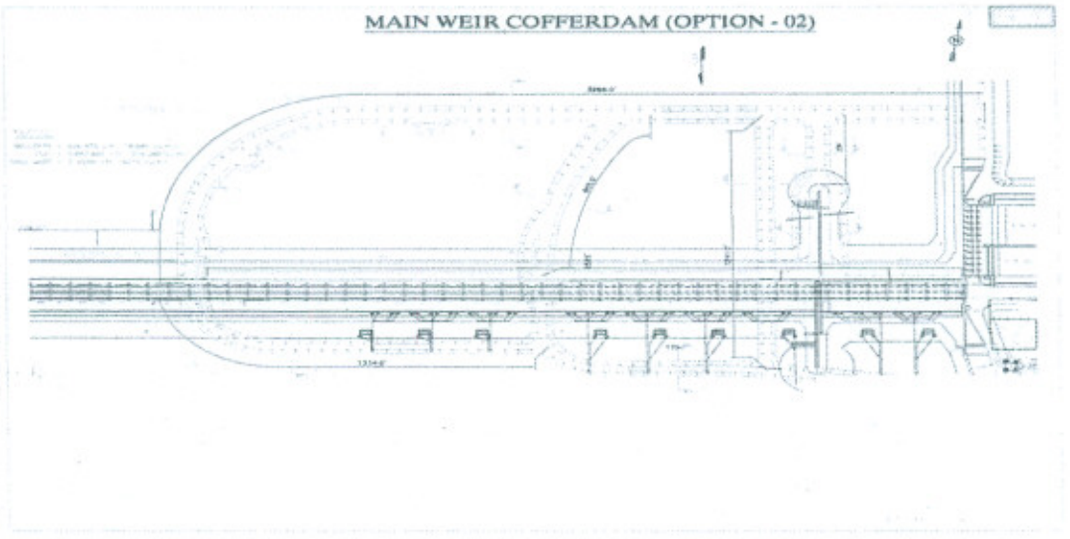
CONTRACT ICB-01 – SCOPE OF WORKS

- **Sub Weir**
  - A 4,346 ft long Subweir 925 ft. d/s of the barrage.
  - Provision of two fish ladders and a navigation lock
  - Instrumentation.
- **Existing Barrage**
  - Grouting of cavities under the floor.
  - Strengthening of barrage glacis and stilling basing floor
  - Provision of Silt Excluder in the right pocket.
  - Raising the sill of the DGK Canal Head Regulator
  - Installation of monitoring instruments in the floor.

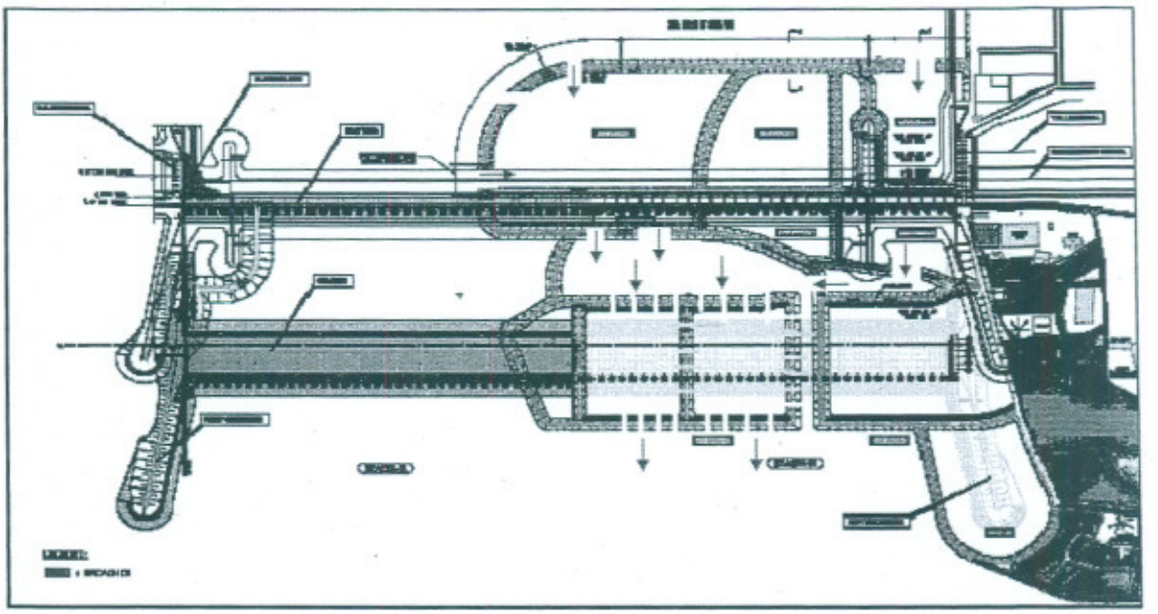
CONTRACT ICB-01 - STAGE-01 WORKS (SEPTEMBER 2005 – JULY 2006) COMPLETED

- Construction of silt excluder in the right pocket of the barrage
- Raising the crest of DG Khan canal by 1 ft.
- Rehabilitation and strengthening of downstream glacis and stilling basin floor of the barrage in bays # 32 to 65
- Construction of the subsidiary weir in right half length (2173 ft).
- Improvement of right fish ladder and its extension on the downstream.
- Extension of D/S right guide bank.
- Installation of sill beams in bay # 43 to 65 of the existing barrage.

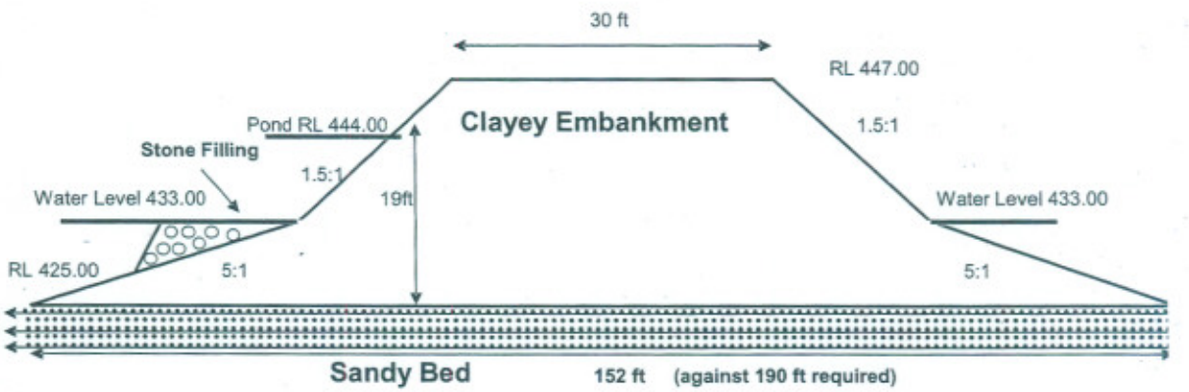
CONTRACT ICB-01
MAIN WEIR COFFER DAM



DETAILS REGARDING INCIDENT OF BREACH ON JANUARY 15, 2007
BREACHES IN U/S LEFT SIDE COFFER DAM



COFFER DAM FAILURE MODE



BREACH CLOSING OPERATION

- Closing of main breach with stone
  Completed on Jan 19, 2007
- Closing of small breaches with earth work
  Completed on Jan 19, 2007
- Laying of filter material up stream of stone boom in the main breach.
  Completed on Jan 20, 2007
- Sealing by filter by laying earth work on U/S side
  Completed on Jan 22, 2007
- Restoration of d/s coffer dam in front of left under sluices
  Completed on Jan 23, 2007

BEACH CLOSING WORKS IN PROGRESS

PROJECT COST

	Rs.in Million
➢ TOTAL COST	11,232
➢ ICB-01 Cost (WB Financed)	4,709
➢ ICB-02 Cost (WB Financed)	1,557
➢ JICA Work Cost (Grant)	2,927
➢ **Sub-Total**	**9,193**
➢ *Other charges (IDC, Duties, Taxes etc)*	2,039

After the presentation the delegates were taken around construction of left half of Sub-Weir 925 ft. Downstream of the Barrage and rehabilitated of Bays No. 1 to 31.

The delegation members were hosted a generous lunch by the Project Management and thereafter the members departed for Lahore.

WELCOME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering Congress approved Membership of the following new members in to the Congress fold. The Engineering News congratulates all of them and welcomes them to PEC

Members admitted on 23-06-2007

1 Engr. Muhammad Bilal Arshad
2 Engr. Naveed Ahmad
3 Engr. Syed Atif Hassnain
4 Engr. Muhammad Imran Malik
5 Engr. Syed Kamran Wasti
6 Engr. Uzair Waheed
7 Engr. Muhammad Anwar-ul-Haque
8 Engr. Muhammad Naveed Sadiq
9 Engr. Muhammad Adnan Jalil
10 Engr. Zafar Iqbal
11 Engr. Madiha Ahmad
12 Engr. Muhammad Asad Imran

Welfare of Engineers

Pakistan Engineering Congress contributed Rs. 5 Lac towards treatment of the gravely ill Engineers from its welfare funds and requested Chief Minister Punjab to arrange the liver transplant at Govt. expense to alleviate the distress of the ailing Engineers and his family.

OBITUARY

May her soul rest in Peace

1. Mother in Law of Engr. Ch. Ghulam Hussain Secretary Pakistan Engineering Congress, breathed her last on April 28, 2007.

THE CONSTRUCTION OF ECONOMIC MECHANICALLY-STABILISED EARTH WALLS IN REMOTE LOCATIONS

Nigel E Wrigley
NewGrids Limited, UK

ABSTRACT:

The development and use of a Mechanically Stabilised Earth Wall (MSEW) system that can readily be utilised in remote areas, which has become popular in China in recent years, is described. The concrete facing blocks are wet-cast in simple moulds that can be readily transported to any location, or even made locally. This enables the construction of high-quality, durable MSEWs economically in remote locations. Also described is how green-faced MSEWs can be constructed with local fill by local labour without the use of expensive formwork.

INTRODUCTION

Mechanically Stabilised Earth Walls (MSEWs) are among the most common and durable geosynthetic-reinforced soil structures. As local fill can generally be used they are economic and can be constructed with relatively unskilled labour. Many Proprietary systems have been devised, often patented, and widely used over the past 25 years in developed regions. However, the majority of systems now in use are not suitable for use in remote areas such as many affected by the Tsunami in South Asia in December 2004. These systems incorporate proprietary concrete facing blocks, manufactured on automatic machinery that are expensive to transport to remote areas.

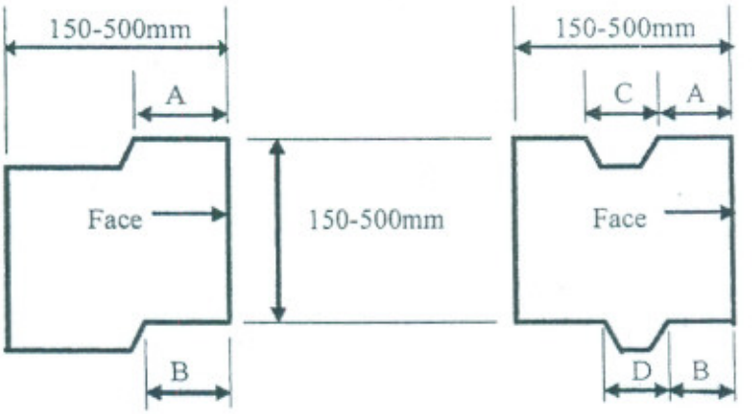
This situation was found in China when engineers were looking to also adopt MSEWs for infrastructure development. There were relatively few local block makers with suitable automatic machinery. Instead they turned to principles of a system that had been used occasionally in the West in particular circumstances. In this system, concrete wall blocks are wet-cast, with a "tail" of HDPE geogrid cast into the body and exiting the rear face. As a wall is constructed with such blocks lengths of reinforcing geogrid are connected to the "tails" as described below. The block moulds are inexpensive and readily transported to a job location. Then block manufacture and wall construction can be done by local labour with minimal supervision.

There are also circumstances in which the durability of a concrete face to an MSEW is not needed, or where a green face would be desirable. In most South Asia locations such structures can also be readily built by local labour as described below.

PRINCIPLES OF BLOCK DESIGN

One of the advantages of using block-faced MSEWs is that they are generally constructed "dry". The blocks sit course-upon-course with no mortar joints. To enable this, the design of the block must be such that the blocks of one layer are prevented from sliding

out over the layer below as the back-fill is compacted. Possible designs include "Z" blocks and "Tongue & Groove" blocks as shown in figures 1(a) and (b).



"Z" Block Tongue & Groove Block

Figure 1: Possible Block Cross-Section Shapes

Points of note regarding the design of blocks are:

? The face may be of any form selected by the designer. For example smooth or exposed aggregate. Some shaping of the face improves the appearance of the wall.

? Normally, Dimension A is slightly larger than Dimension B to give a batter to the wall.

? For ease of manual handling, blocks of up to 200mm high x 250mm deep x 400mm wide, weighting about 40kg are suitable. If mechanical lifting facilities are available larger blocks can be used, e.g. to give sufficient mass to resist heavy wave action.

? Special blocks with flat bases may be required for the bottom course or flat tops for the top of the wall. Both of these can be readily accommodated with simple mould modifications.

INCLUSION OF GEOGRID IN BLOCK AND BLOCK MOULDS:

At each block course in the wall where geogrid reinforcement is required blocks are used with a "Tail" of geogrid cast into them. A moulding arrangement suitable for producing these blocks is illustrated in Figure 2.

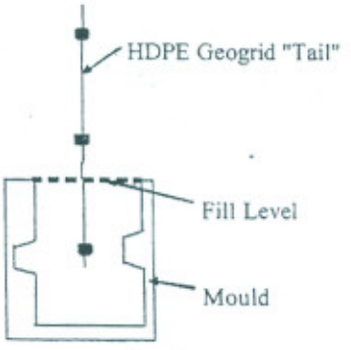


Figure 2: Block moulding with Geogrid "Tail"

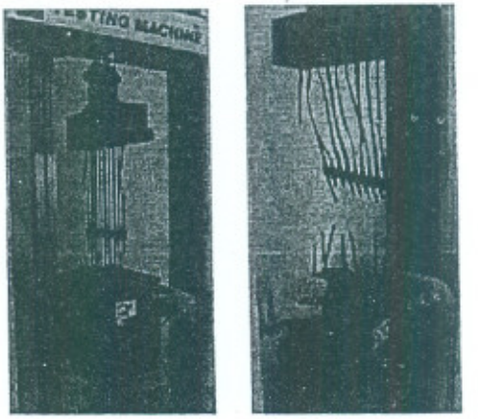


Figure 3: Geogrid "Tail" Embedment Testing

To determine whether the simple embedment of one transverse bar of the geogrid in the block was sufficient for good joint strength a range of experiments were carried out. These are illustrated in Figure 3. On the left is shown a sample ready for test, with a typical test outcome on the right. Embedment depths of 100mm and 140mm were tried, with and without a steel bar threaded through the geogrid just above the embedded transverse bar. It was found that all conditions tested gave a joint strength of 100% of the geogrid strength. Therefore, the simple embedment of 100mm was adopted for production.

Moulds used by one manufacturer for such wall blocks are shown in Figures 4 & 5.

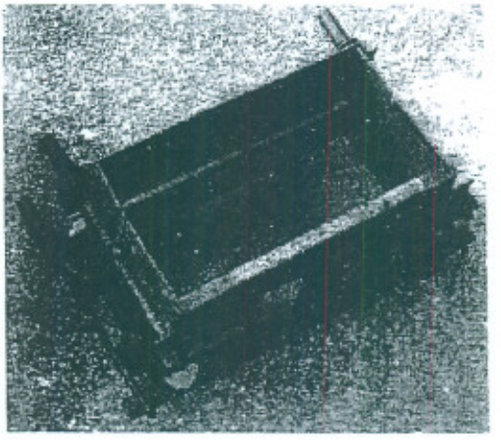


Figure 4: Assembled Mould

Figure 5: Mould Parts

Several useful features can be seen in Figure 5:

? The mould parts can be stacked for ease of transport.

? The block manufactured from this mould is tapered from front face to rear face. This taper (approximately 5° per side) is sufficient to allow the construction of curved walls if required with a radius of less than 2.5m. To allow this articulation, Dimension C in Figure 1 is approximately 15mm greater than Dimension D.

? Slots visible in the sides of the mould are for positioning the Geogrid "Tail" during casting.

? The manufacturing cost for such moulds in China is approximately US$50 each.

A block manufactured from this design of mould is shown in Figure 6.

Figure 6: Finished Block

JOINING OF REINFORCEMENT TO GEOGRID "TAIL":

Lengths or reinforcing geogrid are fastened to each Geogrid "Tail" by means of a "Bodkin" Joint as illustrated in Figure 7:

Points of interest with regard to this joint are:

? The "Bodkin" is a flat bar made from HDPE supplied by the geogrid manufacturer specifically for use with his geogrid. It is important that the correct "bodkin" is used as use of the wrong size will result in reduced strength joints.
? After making a joint as illustrated it must be pulled tight before fill is placed on the length of reinforcement.

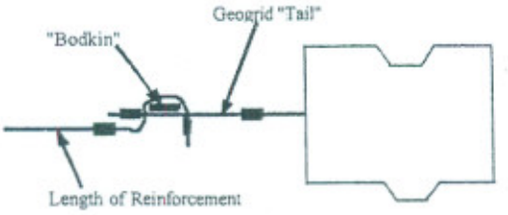


Figure 7: "Bodkin" Joint

PRINCIPLES OF WALL CONSTRUCTION:

The principles of wall construction are illustrated in Figure 8 below:

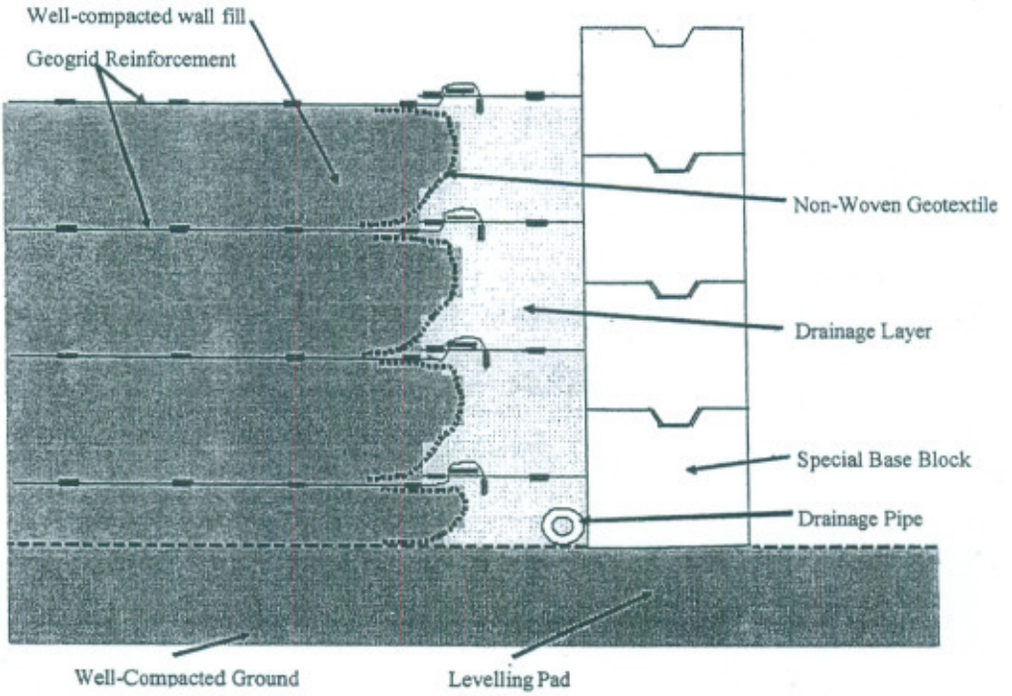


Figure 8: Principles of Wall Construction

Points of interest in the construction are:
? The designer must ensure that the ground is well-compacted and suitable to bear the loads imposed by the wall.
? The levelling pad may be of concrete, mortar, compacted granular fill, or other suitable material
? If the wall fill is free-draining then the Drainage Layer and Non-Woven Geotextile filter may be omitted. If the wall fill is not free draining then a drainage blanket must be installed behind and below the reinforced block.

? During Construction heavy plant and compaction equipment must not be used within 2m of the wall face. In this region light compaction equipment such as a vibrating plate must be used with thin layers of fill.

CONSTRUCTION SEQUENCE:

The construction sequence for such walls is:

1: Prepare the Levelling Pad and lay the base course of blocks, ensuring strict level and alignment and place Drainage Pipes in position.

2: Hold the geogrid "Tails" up out of the way and lay and compact Drainage Layer, Non-woven Geotextile and Wall Back Fill to the level of the Geogrid "Tails".

3: Fasten the first layer of reinforcement Geogrid to the "Tails", stretch it out away from the wall to tighten the joints and lay the next layer of fill on it.

Note: Do not drive any equipment directly on the geogrid. Place fill first.

5: Lay the next course(s) of Blocks up to the next layer of reinforcement

5: Complete laying and compacting drainage layer, non-woven geotextile and fill to the level of the next layer of reinforcement.

6: Repeat this sequence to the top of the wall.

Such constructions can be readily built in remote locations by local labour. The only materials that must be imported to the site are cement, moulds, geosynthetics and light construction equipment. In most circumstance it will be possible to win concrete sand and wall fill materials locally. Standard designs can be tabulated for common circumstances, e.g. a range of typical heights, and applied as required.

EXAMPLES OF FINISHED STRUCTURES

Examples of structures built using this technique are shown in Figures 9 & 10:

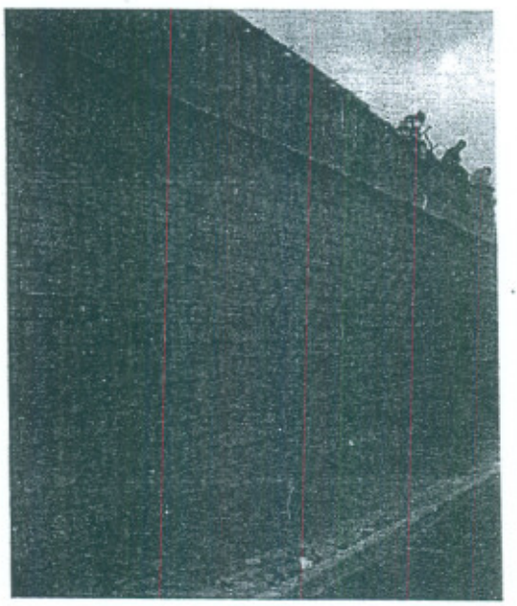


Figure 9: Wall for Road

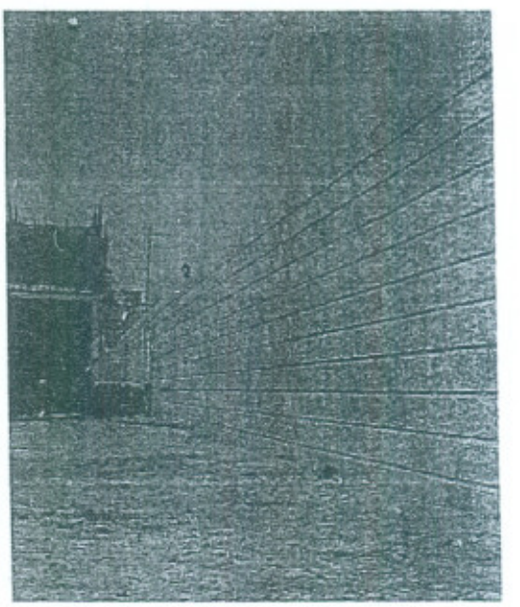


Figure 10: Waterway wall

GREEN WALLS

There are many situations where a steep, vegetated slope or wall is more appropriate than a concrete-block face. In the climate South Asia this will often provide an environmentally sympathetic solution to a need for a level change or barrier. The principles of construction of this form of MSEW are illustrated in Figure 11 and an example is shown in Figure 12.

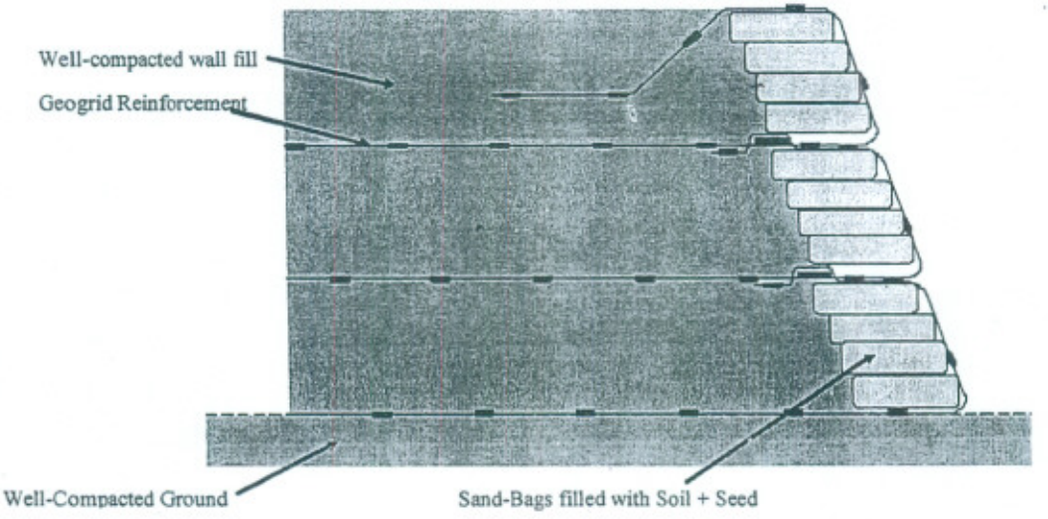


Figure 11: Green Wall Construction

Points of interest in this construction are:

? Each layer of reinforcement wraps up around the Sand-Bag facing and back into the wall.
? The end of each wrap-around is joined to the layer of reinforcement above by a "Bodkin" joint and tightened against the Sand- Bags by tension into the fill on this next layer of reinforcement.
? The seed + soil mixture in the Sand-Bags should be selected to match local conditions and plants.

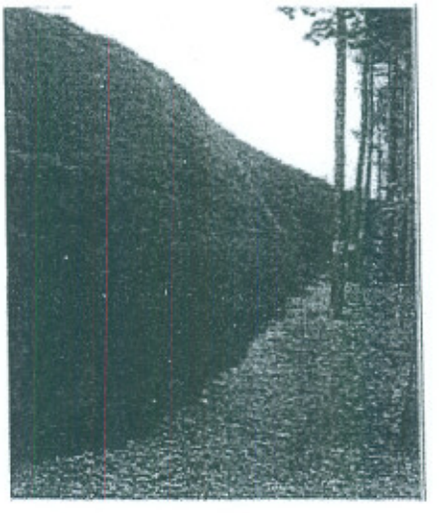


Figure 12: Green Wall

CONCLUSIONS

In remote areas conventional retaining walls and most proprietary MSEWs are expensive to construct. The former because of the cost of transporting heavy equipment and form-work to site. The latter because of the need for concrete wall blocks to be centrally cast and then transported to site.

The MSEW systems discussed in this paper are economic to construct in remote areas. Where concrete wall blocks are required they can be locally cast using low-cost moulds that can readily be transported to site, or even made locally. Both block-faced and green-faced structures can by built using inexperienced local labour

ACKNOWLEDGEMENT

The author wishes to thank the Qingdao Etsong Geogrid Co., Ltd and BOSTD Ltd. for their permission to use their pictures to illustrate this paper.

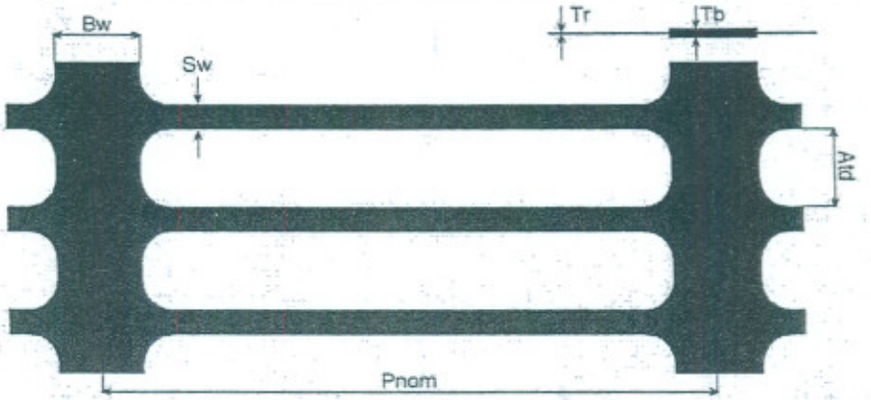
BOSTD Geosynthetics

Specifications:

UNIAXIAL GEOGRIDS

Specifications

Properties									Typical Dimensions mm						
Product	Tensile Strength (KN/m) (1)	Tensile Load (KN/m) 2% strain	Tensile Load (KN/m) 5% strain	Typical Strain at Peak Load (%)	Ultimate Creep Limited Strength For 120 Years (KN/m)(2,3) 10℃	20℃	30℃	Weight (Kg/m²)	Atd	Bw	Sw	Tb	Tr	Pnom	Standard Roll Sizes(5)
E'GRID 170R	170.0	52.5	103.0	11.5	75.8	68.3	61.5	1.1	16	18	6	7.4	2.0	255	50m²(1.0mX50m)
E'GRID 130R	141.9	38.0	75.5	11.5	63.3	57.0	51.3	0.8	16	18	6	5.6	1.6	255	50m²(1.0mX50m)
E'GRID 110R	112.0	29.9	56.5	11.5	49.9	45.0	40.5	0.7	16	18	6	5.0	1.3	255	50m²(1.0mX50m)
E'GRID 90R	90.0	23.7	45.2	11.5	40.2	36.2	32.6	0.55	16	18	6	4.1	1.1	255	50m²(1.0mX50m)
E'GRID 65R	68.7	16.1	30.9	11.5	30.6	27.6	24.8	0.4	16	18	6	2.9	0.8	245	50m²(1.0mX50m)
E'GRID 50R	54.0	12.7	24.7	11.5	24.1	21.7	19.5	0.3	16	18	6	2.1	0.6	235	50m²(1.0mX50m)



Note 1 Measured in accordance with ISO10319 at 20 ± 2℃; calculated as the 95% lower confidence limit in accordance with ISO2602 1980 (BS 2846 Part 2 1981).

Note 2 Calculated from data obtained in accordance with ISO13431; creep strength predicted for 120 years design life, taking account of prediction and Production.

Note 3 For in-soil design temperatures as shown.

Note 4 In accordance with BS2782 Part 4, Method 452B, 1993.

Note 5 Other roll sizes are available to order

Polymer: High Density Polyethylene

Resistance to Ultra-violet Light:

A high level of resistance to U-V Light is given to E'GRID Geogrids by the incorporation of ≥ 2% of weathering-grade carbon black,(4) well dispersed in the polymer matrix. These products may be used for many years in exposed conditions.

Creep Performance:

A good creep performance under sustained loading is essential for the use of geogrids in critical structures such as walls, abutments and steep embankments. BOSTD (Qingdao) Geosynthetics Co., Ltd. maintains constant Creep testing programmes in its laboratories and works closely with National and International experts in the performance of geogrids to ensure that its products meet the strictest demands in all markets.

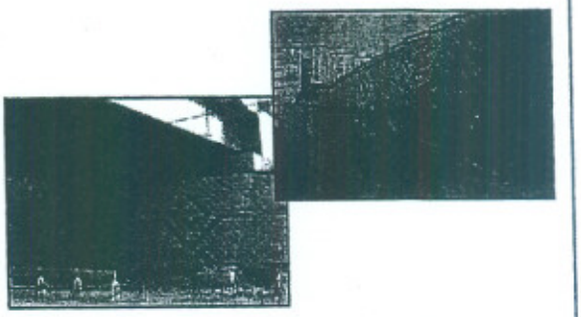
Chemical and Biological Resistance:

E'GRID uniaxial Geogrids are manufactured from high density polyethylene which is unaffected by all chemicals, including acids, alkalis and salts, normally found in soils. Also, it is not a nutrient, therefore, these products are not affected by micro-organisms in soil.

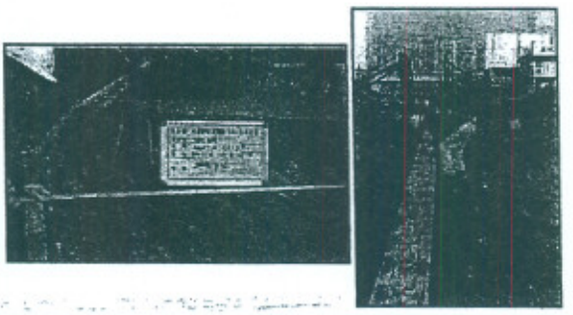
THE CONSTRUCTION OF ECONOMIC MECHANICALLY-STABILISED EARTH WALLS

Nigel E Wrigley
NewGrids Limited, UK

MSEW
(Mechanically Stabilized Earth Walls)



MSEW
(Mechanically Stabilized Earth Walls)



Advantages of MSEW's

- Quick, Economic Construction:
  - No formwork, shuttering, scaffolding
  - No heavy equipment
  - Dry construction
  - Local labour
- Flexible
  - Withstand some ground movement
  - Withstand shock loads
- Corrosion-free
  - No steel reinforcement

Disadvantages of most MSEW systems

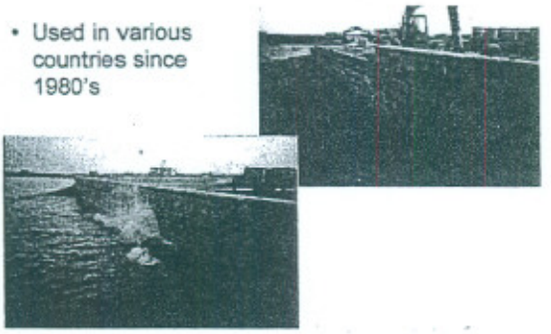
- Proprietary
  - Restricted sources of supply
- Factory-made blocks
  - Either: not available locally away from industrial centres
  - Or: expensive because of transport costs
- Friction Connection of Geogrid to Blocks

Ideal Wall System for Remote Areas or Disaster Relief

- Use local labour
- Minimum transport costs
  - minimise weight and volume of materials and equipment to be transported
- Possible options
  - Local-cast concrete blocks
  - Green face with no blocks
  - Combination

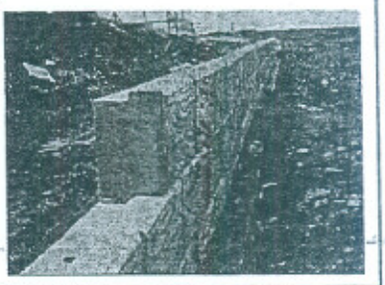
Walls with Local-cast Blocks

- Used in various countries since 1980's



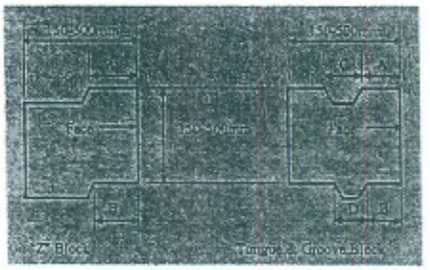
Walls with Local-cast Blocks

- Used in various countries since 1980's



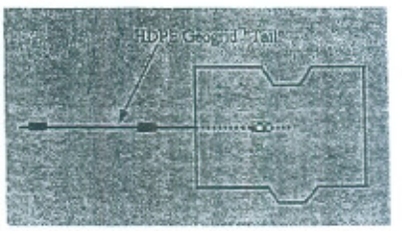
Walls with Local-cast Blocks

- Design



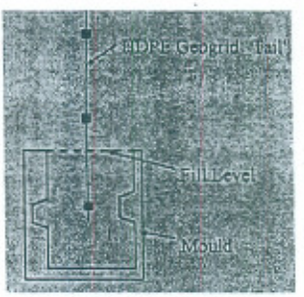
Walls with Local-cast Blocks

- Connection of Block to Reinforcement



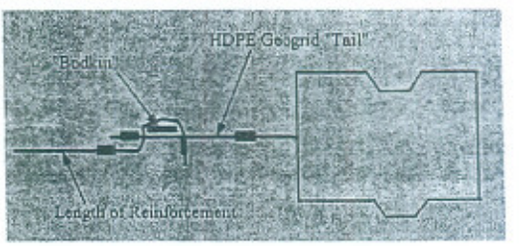
Walls with Local-cast Blocks

- Connection of Block to Reinforcement



Walls with Local-cast Blocks

- Connection of Block to Reinforcement

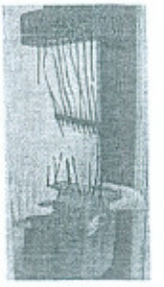


Walls with Local-cast Blocks

- **Why HDPE?**
- Strength:
  - Seismic strength = 2 x Static Strength
- Chemical Resistance:
  - Unaffected by enclosure in concrete
- Bar-Rib Junction Strength
  - 100% of Rib Strength
  - Bodkin joint

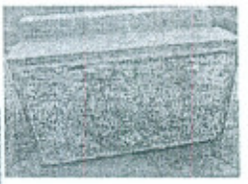
Walls with Local-cast Blocks

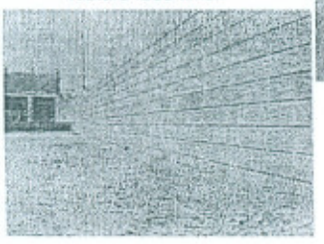
- Junction Strength



Walls with Local-cast Blocks

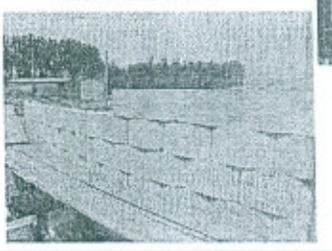
- Design
  - Use a shaped or feature face finish





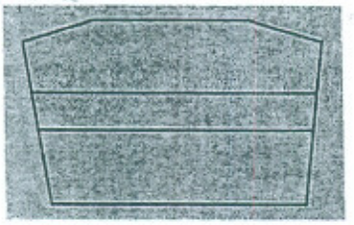
Walls with Local-cast Blocks

- Design
  - Use a shaped or feature face finish



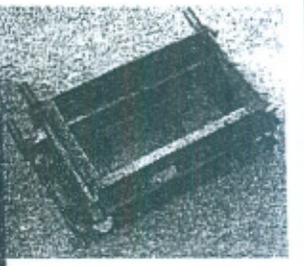
Walls with Local-cast Blocks

- Design
  - Allow for curved walls



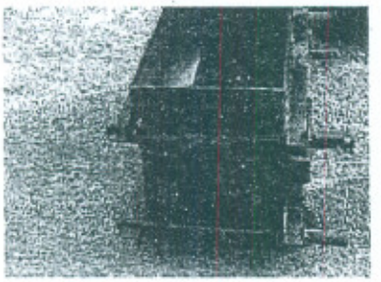
Walls with Local-cast Blocks

- Block mould



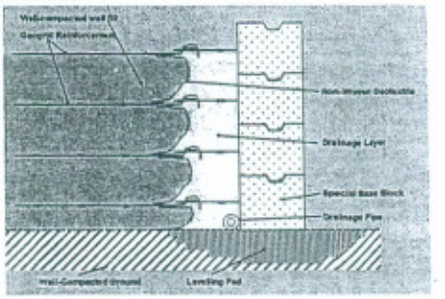
Walls with Local-cast Blocks

- Block mould



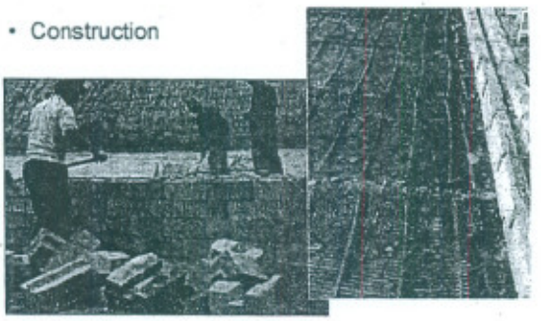
Walls with Local-cast Blocks

- Construction



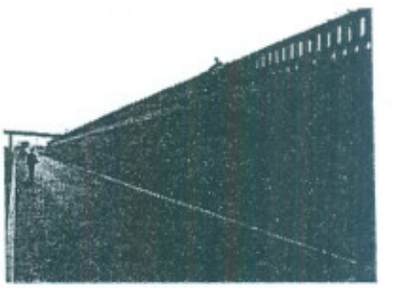
Walls with Local-cast Blocks

- Construction



Walls with Local-cast Blocks

- Examples

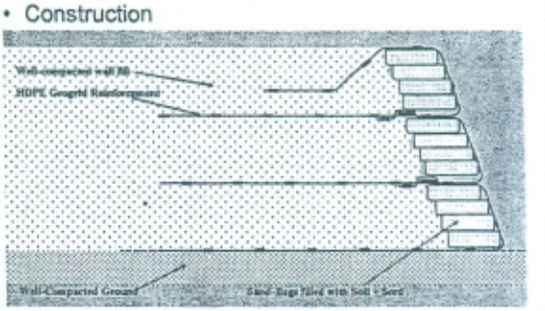


Walls with Local-cast Blocks

- Examples

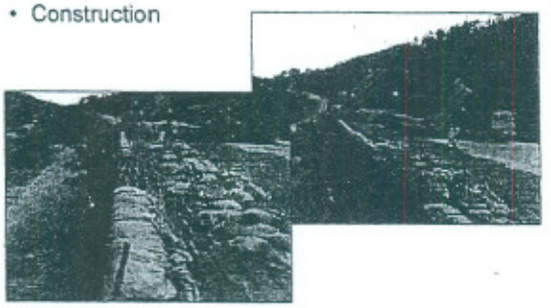
Walls with Green Face

- Construction



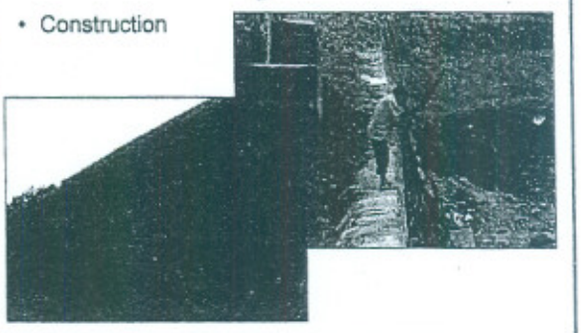
Walls with Green Face

- Construction



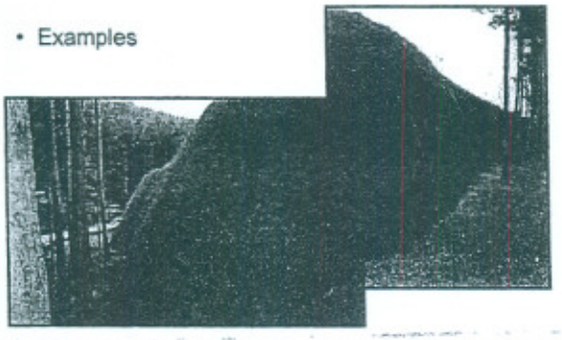
Walls with Green Face

- Construction



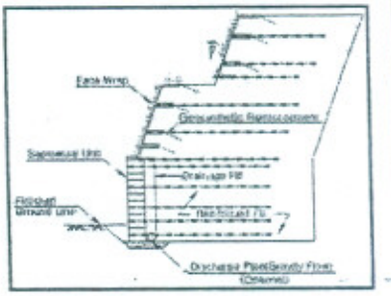
Walls with Green Face

- Examples



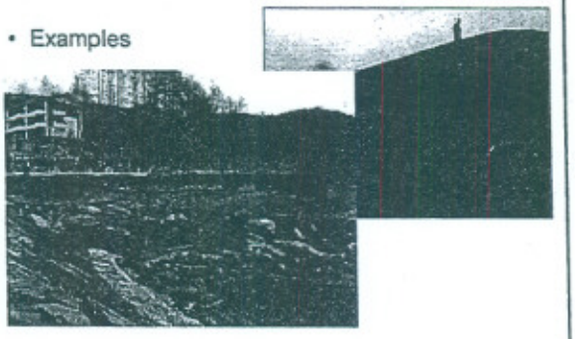
Walls with Combination Faces

- Concept



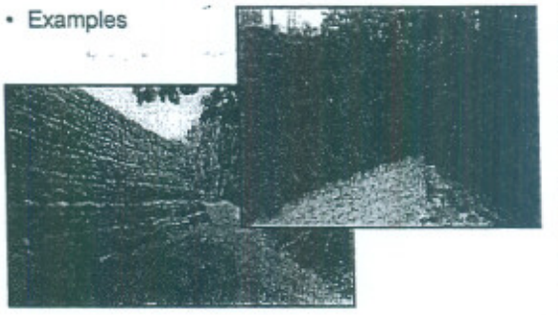
Walls with Combination Faces

- Examples



Walls with Combination Faces

- Examples



Walls with Combination Faces

- Examples

Advantages of MSEW's

- Quick, Economic Construction:
  - No formwork, shuttering, scaffolding
  - No heavy equipment
  - Dry construction
  - Local labour
- Flexible
  - Withstand some ground movement
  - Withstand shock loads
- Corrosion-free
  - No steel reinforcement

Ideal Wall System for Remote Areas or Disaster Relief

- Use local labour
- Minimum transport costs
  - minimise weight and volume of materials and equipment to be transported
- Possible options
  - Local-cast concrete blocks
  - Green face with no blocks
  - Combination

My Thanks

- To you
- To Professor Bergado and the Symposium team
- To The Qingdao Etsong Geogrids Company and BOSTD, Beijing

DE-VEGETATION-A MAJOR CAUSE OF DESERTIFICATION IN SANDY ARID LANDS OF PAKISTAN

By

Amin U Khan*

ABSTRACT

Natural plant communities in arid sandy areas are generally regarded as biosphere regulators, and are also important source of raw materials for society. The over consumption of these resources at an accelerated pace has not only eroded the country's economic base but also debilitated its life-support ecosystems. At the moment unplanned agriculture and livestock production in arid sandy areas is causing a decline in perennial vegetation creating more problems and offsetting gains in productivity. This situation calls for the need to devise a strategy for the conservation of these resources in arid sandy areas, especially, where they are most vulnerable and endangered. This study attempts to identify the weaknesses in the governance of arid areas in Pakistan, where poor management policy of the government resulted in de-vegetation of fragile sandy soils. This abuse has resulted in extensive desertification in the region. The study recommends an ecological framework for the management of these resources. It suggests that the government should adopt a scheme based on valuations of productive and protective benefits of conserving and restoring natural vegetation in selected demonstration sites.

INTRODUCTION

Vegetation here denotes that assemblage of perennial plants that have evolved to cope with climatic and edaphic extremes and in return enhance fertility of soils and increase productive capacity of the area. Since social and ecological benefits of this vegetation are intangible, therefore the policy makers determine their value primarily on the basis of the rent producing capacity of the area. At the moment livestock production is the primary utilization of the area, in spite of the concomitant reports of drought and famine coming from this region there is casual and inadequate response to this ecological deficits (Khan, 2003). This is an indication that planners are deliberately ignoring the externalities, and thus transferring the cost to the nation as a whole.

In Pakistan economic deficits are dominating our headlines but we are unaware of the looming ecological deficits. The arid areas of Pakistan are replete with examples of unsustainable use of natural vegetation on economic grounds. Historical records and recent surveys (Khan, 1994, 1996, Khan and Iqbal, 1999) indicate that de-vegetation is the primary cause of creation of deserts in Cholistan, Thal and Thar. To conserve the vegetation in these areas it is essential to take ecological valuation of all species into consideration. Since decision makers and consumers are geographically far away from environmentally sensitive areas it is easy for them to ignore the negative environmental impacts in these regions. It is this attitude that contributes to the human assault on these fragile ecological systems. The solutions to this problem are challenging and should be based on striking the right balance between exploitation, sustainable use and degradation of the sandy arid lands.

The first part of this paper presents an overview of the state of the arid sandy land and the reason of their overexploitation. The second part suggests an ecological framework for the solutions to the problems linked with vegetation depletion and desertification.

A. AN OVERVIEW OF THE STATE OF DE-VEGEATION IN SANDY ARID LAND

The sandy arid drylands of Thal, Cholistan and Thar which comprise of an area of 4, 500,000

*Chairman Department of Botany & Environmental Sciences GC University Lahore, Pakistan

hectares of degraded land, originally had a cover of species which evolved over the years to cope with climatic and edaphic extremes. The natural vegetation (desert thorn forests), comprising scattered indigerous trees with undergrowth of shrubs and grasses, formed an assemblage, which provided sustainable fodder and shelter to wildlife, livestock, fruit, medication, recreation and most importantly, famine food to the inhabitants in drought (Khan, 1994, 1996). The incentives to convert them into arable land in irrigated regions were, no doubt, appropriate but in regions away from irrigation network it has resulted in the desertification of sandy fragile soils. The relicts of intact thorn forest communities now survive as isolated specimen (Fig. 1) in remote areas of Thal, Cholistan and Thar.

Fig.1 Isolated Specimen of *Salvadora oleiodes* showing early sign of desertification.

1. Attributes Of The Perennial Vegetation Of Sandy Arid Lands

The original vegetation from Punjab plains to Arabian sea is represented by two species i..e, *Salvadora oleoides* and *Prosopis cineraria*. Intact patches (Fig. 2) of association between the two species survive in protected rangelands of Rakh Khaeriwala and their positive spatial relationships has been described (Rasool, 2001) both above ground and in the root architecture (Fig. 3).

Fig.2 The intact community representing the climatic and edaphic community in the protected Thal forest (stem boles of *P. cineraria* and shrub like growth of *S. oleiodes*)

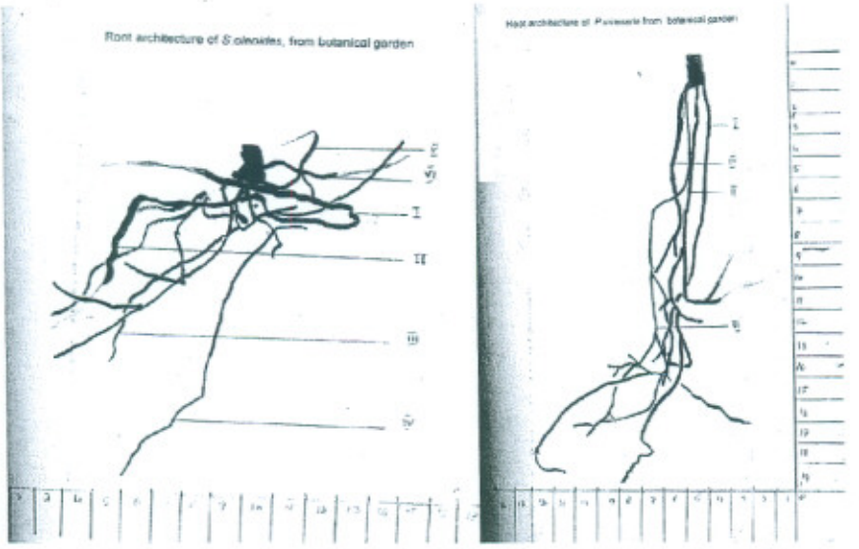


Fig.3 The lateral root architecture of *S. oleiodes* and the tap root architect of *P. cineraria*.

The lateral spread of species is greater in *S. oleoides*, whereas vertical pattern is more obvious in *P. cineraria*. These differences in space occupation allow the two species to coexist in harsh desert environment and it is an adaptation to overcome water stress. This association provides intense cover to the soil and enrich the soil with nutrients and organic matter at the same time, whereas the below ground biomass plays a significant role in the survival of the species in the desert environment and stabilizing the sandy soils. Once these species are removed it affects their association and make the surviving species more vulnerable to drought. Removal of both these species leads to instant desertification. Re-colonization of these desertified patches is a slow process and may take hundreds of years. And even that is not possible in these areas, as most of the colonizers are uprooted thus exposing the fragile soil and spreading further the process of desertification. Presently, areas around settlements present a dismal picture, as the land has lost its life support capacity, rendering it useless to native livestock and wildlife. Although re-colonization by weeds indicates the start of the reversal process, but huge resources are required to restore this area to its original natural state. Observations in the desert indicate that the following factors accelerate the process of de-vegetation and hence desertification in the arid sandy areas of Pakistan.

2. Causes of De-Vegetation

The factors listed below are considered (Khan, 2003) as major causes of desertification in the arid plains of Pakistan.

i) Inappropriate Livestock Management: Local herders enjoy unlimited grazing rights causing enormous devastation. The dire need for cash has resulted in 80% growth of livestock population in the past two decades. (Hasan and Hasan, 1998; Khankhangharani, 1999; WWF, 2000). This increase has caused extensive desertification and further deepening drought in the areas. Cultivated irrigated areas, which are privately owned, no longer cater to the fodder needs of this growing livestock population. Cattle and sheep mainly dependent on grasses and herbs, constitute 70% of the total livestock population. They are dependent on rain for the scarce fodder. As a result, forage production in arid land is not only highly variable, but also of low quality. This increase in livestock has reduced available grazing land putting extra pressure on the surviving vegetation.

ii) Government Land Grant Policy: The agriculture is growing in rangelands at about the same rate as growth in population. This has brought additional land under cultivation which otherwise is less suitable for crop production. In these areas the privately owned land is mostly cultivable land,

whereas most of the land belonging to state is considered as communal grazing land. The government land grant policy, which favors local landlords has deprived the population of grazing areas pushing them further deep into remote parts of the region (Hasan and Hasan, 1998).

iii) Excessive Removal of Woody Plant for Fuel: Indigenous trees and shrubs essential for the stability of these sandy soils are being ruthlessly used for consumption in the construction of houses and supply of fuel for cooking. In the beginning, the fuel wood requirements of nearby irrigated towns were met by trees and shrubs from adjacent desert areas. With the disappearance of trees from these areas, people have now started exploiting remote deserts areas for fuel wood. Tractor-trolley loads are common sites where exploitation is being done on commercial basis (Fig. 4).

Fig.4 Tractor-trolley loads of *Calligonum polygonoides* to be sold as fuel in the local market.

The process of desertification sets in with the removal of natural vegetation, and the process of natural succession has been halted because colonizer plants (e.g., *Calligonum polygonoides*, *Leptidinia pyrotechnica*, *Haloxylon salicornicum*, *Haloxylon recurvum*) have either been uprooted or consumed locally or sold for cash in the local market.

iv) Misconception: There is also a misconception among rangeland and livestock experts that a perennial palatable grassland (*lasiurus-cenchrus*) forms a stable plant community in the desert environment, as a matter of fact it is highly susceptible to the process of desertification (Fig. 5). These ecological facts are never given much consideration and in spite of all the evidences, some reports (PARC, 1987; WWF, 2000) hesitate to admit that livestock and the herders are the main element in desertification; instead, climatic factors are blamed for this degradation. Stability in these areas can only be achieved when forage grows along with natural vegetation communities.

v) Insufficient attention: These fragile ecosystems have been over-exploited mainly because of weak ownership and failure of traditional control mechanisms. The communities of arid lands have low level of income, few community services, and poor level of education. Herders and farmers are notorious for constant encroachment upon public land and insufficient attention leads to depletion of natural vegetation.

vi) State sponsored perverse incentives: Present economic policies are geared to the interests of the present at the expense of future generation. The country's income tax laws generally exempt livestock production and agriculture in arid lands. This prevailing system of

investment incentives, credit and concessions and agricultural pricing policies are damaging the life-support capacity of the arid land.

It is obvious that planners, confronted with monetary problems, are forced to use arid land for fodder and fuel. This allows the traditional subsistence farmers and herders with growing economic pressures to over-consume, thus ignoring the long-term stability of the area. In turn, desertification is spiraling out of control and also affecting the welfare of the developed areas. In fact it has now assumed the form of a vicious cycle where rapid population growth and loss of job opportunities in the resilient areas are resulting in the rapid desertification. In the developed countries there is a tendency to adopt more conservative forms of land-use with intensive forms of land-use management for such areas. Furthermore, a strong linkage to a market economy makes it easier for them to influence land use by changing property rights and manipulating market prices through subsidies where necessary. Like wise in Pakistan, the government should pave the way for restraints on exploitative use of resources in arid ecosystems.

B. ECOLOGICAL FRAMEWORK FOR SANDY ARID ECOSYSTEMS

The National Conservation Strategy of Pakistan (Government of Pakistan, 1992) focuses on objectives and operating principles, laying greater emphasis on public participation in development and environment management, and a merger of environment and economics in decision making. However, it fails to explain linkages between ecological and economic developments of inherently fragile ecosystem and national economy (Khan, 2003). Environmental protection based on ecological principles is the key to successful management of fragile ecosystems. Under the present circumstances, it is essential to distinguish between the capacities, and responses to manipulations, of productive and protective ecosystems. The protective ecosystems are inherently fragile. On the other hand, productive ecosystems, such as modern agriculture and forestry in the irrigated regions are resilient. Failure to distinguish between fragile and resilient areas would naturally lead to applying and implementing the same type of thinking for fragile ecosystems, creating more serious environmental problems. Unfortunately in Pakistan we have yet to realize the basic differences in the potentialities of these two ecosystems. In order to appreciate the differences one has to realize that in resilient regions (cultural ecosystem) the framework has to be based upon human ecology. Whereas the framework for fragile areas has to be based on ecologically oriented model, laying emphasis on the dependence of human beings on the environment. For fragile areas, functional integrity of ecosystems matters most for the survival of environmental resources. This ecosystem framework can rarely, if ever, be appropriate for cultural ecosystems, because it implies automatic feedback control as opposed to societal control of man-environment interactions based upon human ecology (Gleaser, 1995). Since, ecological framework proposed for the arid sandy areas lays emphasis on conserving and restoring natural vegetation, therefore, by adopting the following guidelines the planners can encourage a policy shift to positive sustainable development.

1. Conserving Natural Resources As Public Goods

In Pakistan the natural resources in fragile ecosystems are still valued strictly on the basis of market prices ignoring positive or negative externalities. Consequently, the government determines land use patterns primarily by rent producing capacity of the area in question, irrespective of its value to society. In fact we are totally ignoring values responsible for maintaining environmental resources, simply, because they are not traded in the market place and therefore they are not reflected in the national income accounts (McNeely, 1988).

Naturally, in the absence of a fair valuation system the herders and farmers would exploit these resources without taking into account full social and economic costs of their exploitation. Consequently these external costs (desertification) are transferred to the nation as a whole. Research in the following areas would help in initiating a fair valuation for the natural vegetation.

i) Establishing linkages between natural resources in fragile arid lands and national economy: In Pakistan, the economy of fragile sandy areas is treated as peripheral to crucial macroeconomics adjustment issues. To catch the attention of policy makers, it is essential to demonstrate the value of wild natural vegetation in real economic terms. To assess this, the government must know the nature of relationship between natural vegetation and national economy. For instance, the misuse of arid areas beyond their carrying capacities is putting additional pressures on existing agricultural land for supply of food, fodder and fuel.

ii) Valuation system for vegetation of deserts: Presently, public goods in fragile ecosystems are available to the consumers at zero price, whereas for the rest of the country they provide protection against encroaching desertification. The conservation of natural vegetation and values and costs of goods and services they provide can be used for cost benefits analysis. Such valuation programs could also help the government in devising national objectives to conserve wild natural resources in critical areas. This clearly requires the human population to be organized according to the carrying capacity of the resources or the abandonment of nomadic lifestyle or temporary settlements. It will also help in predicting the community's immediate and future costs if the natural resources are degraded. Latin American, African and South Asian countries have demonstrated effective ways of protecting fragile areas and their wild natural resources when the entire ecosystem was threatened (Lusigi, 1984; Government of India, 1993).

iii) Economic incentives based on resource valuation: Environmental economists have devised ways to evaluate the benefits of these resources economically (Freeman, 1993; Aylward & Barbier, 1993). It is obvious that a lack of concern for natural resources and their potential benefits has encouraged villagers to become poachers and encroachers. Once the basis of valuation is determined, the next step would be to design economic incentives for reversing policies at the community level.

2. Establishing Demonstration Sites

The above analysis clearly indicate that drastic changes are required to move from exploitation to protection. The government can initiate such changes by eliminating subsidies that are environmentally harmful in these areas and setting up demonstration areas, demonstrating the ecological and economic benefits of wild natural vegetation. These model sites would enable policy makers to extend this practice to other areas. For example Venezuela's Canaima National Park safeguards a catchment feeding hydroelectric developments, The Government has recently tripled the size of the park to 3 million ha to enhance its utility for watershed protection (Garcia, 1984).

Control on heavy grazing and removal of wood, in sandy areas such as Rakh Khairewala in Thal, have been very effective in supporting an intact natural forest (*Salvadora oleoides* and *Prosopis cineraria*). Rakh Khairewala in Thal is regarded as a prime site for the conservation of natural vegetation (Khan (1994). These natural communities maintain fertility of soils and increase productive capacity of such areas. The adoption of similar steps in Cholistan and Thar can help restore natural community and mitigate the effects of drought. The situation calls for a national strategy to provide financial support to areas affected due to decades of heavy use of natural vegetation. An integrated approach based on scientific investigation can provide stimulus to conservation efforts in the area. The plant conservation program in fragile ecosystems should be based upon conserving and rehabilitating vegetation on scientific basis. The protection and rehabilitation of target species in designated areas will provide, through demonstration, the following benefits (Khan, 2003):-

i) Stability of the area: The cover of natural vegetation on thin soils plays a key role by not only providing forage for animals in arid areas but also protecting the landscape from wind erosion. Over-use of vegetation exposes the surface to erosion, reducing future productivity and future landscape protection. Consequently, areas set aside for conservation could be utilized as drought

reserves for grazing in drought and emergencies, for instance, in Kenya traditional drought reserve rangelands were included in the protected area system of the country (Lusigi, 1984).

ii) Providing facilities for research and tourism: Such areas would provide a living laboratory (bench mark) for measuring and assessing changes brought about by other forms of land use. They also provide valuable sites for university students to gain practical education in biology, ecology, geology, geography and socio-economics. Presence of natural vegetation encourages increased tourism, and will act as sanctuary to wildlife driven out of populated areas bringing outside money and providing direct incentives for communities to preserve the area and stimulates local domestic industries.

iii) Buffer to climate change: Anticipated climate change in our region suggests that the arid regions could suffer from frequent droughts (Peters, 1988; Bruce, 1990). Under these circumstances the fragile areas under consideration will be the worst hit areas. Absence of natural vegetation cover will result in further environmental degradation. Retaining a plant cover on such fragile areas allows vegetation to interact with the changing environment and maintain evolutionary fitness and act as a shield against gradual climate change.

3. Maintaining and Improving the Functions of Demonstration Areas

In Pakistan national and provincial environment departments are active to some extent but local agencies are almost non-existent in the natural resource management (GOP, 1992). However, they can be very effective in the implementation of conservation policies. The role of a local agency in the protection of environmental values should be incorporated under state laws. It is this lack of inter-agency (federal, provincial and local) link which prevents better management of natural resources. The National Conservation Strategy (GOP, 1992), in its detailed analysis of present policies and programs related to the environment, rightly pointed out the dearth of legislation for environmental protection and resource conservation. The following points attempt to identify a multidisciplinary mix to find a viable solution to the problem of the conservation of natural vegetation in fragile ecosystems.

i) Natural vegetation act: The existing and proposed forest regulations in this country are designed to maintain and strengthen economic rather than ecological role of the forests. In arid lands, the natural vegetation has low market value but high consumptive-use value for the community. In fragile areas there is an urgent need to make new laws providing protection for all the developmental stages of natural vegetation. As vegetation protects people from erosion and drought the regulations governing their use should be even stricter than for protected forests. For the implementation of new law, the local administration should set up a vegetation protection service at the community level. This service should be responsible for restoring the natural community, repairing damage to the landscape.

ii) Nature conservation act: The nature conservation act should aim at preserving the ecosystem, the diversity and beauty of nature by designating certain zones as core or protected areas. Landowners could be compensated for conservation measures in the buffer zones.

iii) Land-use planning act: This act should aim at the prevention of harmful changes to the landscape and the ecosystem at the community level. The local planning authorities should be charged with the responsibility for designating areas for conservation. This designation should be binding on the community in their development plans. Issuance of permits, under the land use planning act and the real estate transaction act, for the sale of agricultural and public land, would safeguard the interests of the area.

iv) Soil conservation act: The soil conservation act should aim at the preservation of protective functions of farming in fragile areas. It should include improvement of the structure and management of farms through regional programs for providing marketing facilities for livestock,

and registering grazers in order to put them on a firm legal basis. The policy should share with farmers the cost of erosion control practices.

v) Institutional integration: The preceeding analysis indicates that implementing conservation programs in intrinsically fragile areas should be based on participatory and integrated approach of different agencies dealing with the conservation of natural vegetation. Most importantly, there is an urgent need for integrating agricultural and environmental policies (Young, 1991). The failure to integrate policies has resulted in more erosion than would otherwise have occurred. To deal with this problem the farmers should be encouraged to promote heterogeneity in the landscape; by taking some part of their land out of production or grazing and establishing mid-field shelterbelts and strips of vegetation as buffers for landscape management.

CONCLUSIONS

The analysis of fast pace of de-vegetation and encroaching desertification in this study shows that the interdependence among people, nation and the sandy arid land is much greater than commonly imagined. Maintenance of life support capacity of these fragile areas require scientific approaches to ensure their stability and sustainability. Continuing with business as usual will result in further desertification. It is obvious that existing mechanisms regarding the welfare function are outdated and need new initiatives in these areas. The undesirable trends of desertification can only be reversed if policy makers act in a coherent manner.

REFERENCES

Aylward, B.A., and E.B. Barbier (eds.) (1993). "Economic Value of Species Information and its Role in Biodiversity Conservation: Case studies of Costa Rica's National Biodiversity Institute and Pharmaceutical Prospecting. A Report to the Swedish International Development Authority Prepared by the London Environmental Economics Centre, and the Tropical Science Center in Collaboration with the National Biodiversity Institute of Costa Rica.

Bruce, J. P. (1990). "Myths and Realities of Global Climate Change", *Ecodecision* 1: 89-92.

Freeman, A. M. (1993). "*The Measurement of Environmental & Resource Values: Theory & Methods*", Washington, D.C.: Resources for the Future.

Garcia, J. R. (1984). "Waterfalls, hydropower, and Water for Industry: Contributions from Canaima National Park." In *National Parks, Conservation, and Development: The Role of Protected Areas in Sustaining Society*", McNeely, J. A. and K. R. Miller (eds.), Smithsonian Institution Press: Washington, D. C.

Gleaser, B. (1995). Environment, Development and Agriculture. Integrated Policy through Human Ecology, University College: London.

GOP (Government of Pakistan) (1992). *The Pakistan National Conservation Strategy*, Government of Pakistan and IUCN: Karachi.

Government of India (1993). *Eliciting Public Support for Wildlife Conservation*, Report of Indian Board for Wildlife Task Force, Department of Environment , New Delhi.

Hasan, A. and Z. Hasan (1998). *Thardeep Rural Development Programme*. The Story of the Thar Rural Development Project from a Donor Supported Relief Effort to a National NGO, UNICEF: Karachi.

Khan A. U & Iqbal Anjum (1999). Impact of proposed evaporation pond on the vegetation of lesser Cholistan. Biologia 45(1), PP103-105.

Khan A.U. (2003). Conservation of Wild Natural Resources and the need for good Governance in Pakistan. Lead – Pakistan 2000.

Khan, A. U. (1994) History of decline and present status of natural tropical thorn forest in Punjab. *Biological Conservation* 67: 205-210.

Khan, A. U. (1996). "Appraisal of Ethno-ecological Incentives to Promote Conservation of Salvadora oleoides DECNE: The Case for Creating a Resource Area. *Biology Conservation.*, 75: 187-190.

Khankhangharani, S. (1999). An Assessment of Drought in Tharparker Arid Zone Thardeep Rural Development Programme, Tharparker, Pakistan.

Lusigi, W. (1984). "Mt. Kulal Biosphere Reserve: Reconciling Conservation with Local Human Population Needs", In *Conservation, Science, and Society*, J.A. McNeely and D. Navid (eds.). UNESCO-UNEP, Paris.

McNeely, J. A. (1988). Economics and Biological Diversity: Developing and Using Economic Incentive to Conserve Biological Resources, IUCN Gland: Switzerland.

PARC (Pakistan Agricultural Research Council). (1987). Proceedings of US-Pakistan workshop on Arid Lands Development and desertification control (Ed. Hutchinson & Webb). PARC, Islamabad.

Peters, R.L. (1988). "The Effect of Global Climate Change on Natural Communities", In *Biodiversity*. E.O. Wilson (ed.), National Academy Press: Washington D. C.

Rasool, Tausif. (2001). An investigation into the attributes of two climkatic climax species of ntural rthorn Forest.. M.Phil thesis Government College, Lahore.

Repetto, R. (1987). "Creating Incentives for Sustainable Forest Development", *Ambio* 2 (3): 94-99.

WWF (World Wide Fund for Nature-Pakistan). (2000). International Workshop on Conservation and Management of Cholistan Desert 2000. Resources-challenges and Strategies and Cholistan Desert Ecosystem, Monitoring for Future Management, Ghulam Akbar and M. Arshad (eds.). Cholistan Institute of Desert Studies, Islamia University, Bahawalpur.

Young, M.D. (1991). "Overview: the Integration of Agricultural and Environmental Policies", In *Towards Sustainable Agricultural Development.* Michael D. Young, (ed.). Belhaven Press: London.

National Development Consultants

A Multi-disciplinary Organization of Consulting Engineers providing high quality professional services under one roof to its Clients at home and abroad.

FIELD OF SPECIALIZATION

- Irrigation , Drainage and Agriculture
- Dams and Hydropower
- Public Health and Environment
- Roads and Bridges
- Buildings and Urban Development
- Airports and Seaports
- Geographical Information Systems
- Information Technology

SERVICES

- Pre-feasibility & Feasibility Studies
- Surveys
- Planning and Investigations
- Designs and Tender Documents
- Contract Management
- Construction Supervision and Quality Assurance
- Post Construction Services

A Group Photo on the Inauguration of Diamer Basha Dam Project

Sukkur Barrage Rehabilitation Project Completed Upstream Coffer Dam

A view of Concrete lined Canal under the Revamping /Rehabilitation of Irrigation and Drainage Systems in Sindh Project

Drilling for Geo-technical Investigations in Progress with Rotary Rig in the Extension of Pat Feeder Canal Project Extension Area.

A view of Irrigation Channel under Merowe Irrigation and Dam Project in Sudan

A view of Taunsa Barrage Project

A view of Concrete lining with machine in Chashma Right Bank Irrigation Project Stage-III in Progress

A view of Lined Watercourse in Balochistan

WASA Project -Tubewell boring in Progress

Laying and Compaction of Asphaltic Base Course at KM 18+1300 to KM 18+400 Package A at D.G. Khan Rajanpur Road Section

Duber Khwar Project: Excavation

Allai Khwar Project: Off-Loading of Contractor?s Construction Equipment at Power House

National Development Consultants

62-M Gulberg-III, Lahore
☞: (042) 5864930, 5883729, 5860044, 5834447
Fax: (92-42) 5862033, 5837824
E-Mail: ndcho@cyber.net.pk

93-E Model Town, Lahore
☞: (042) 5867773, 5860870
Fax: (92-42) 5869287
E-mail: ndc786@lhr.paknet.com.pk

Web Site: www.ndc.org.pk

ISO-9001 REGISTERED FIRM
Det Norske veritas B.V., Netherlands