# Climate Change
and
# Natural Disasters
in Pakistan

Naseer Memon

SPO
Strengthening
Participatory
Organization
ادارہ استحکام شرکتی ترقی

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*"The views expressed in this publication are those of the author and do not necessarily reflect the views of the organization"*

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# Preface

Climate change is an emerging threat for our planet. It has manifested in disasters of unpredictable frequency and intensity in different parts of world. Pakistan is facing multitude of impacts ensuing from climate change phenomenon. The Super Floods of 2010 and the cyclones of 1999 and 2007, are grim reminders of the fact that we are negotiating a serious challenge posed by climate change.

SPO being one of the largest rights-based non-profit organization of Pakistan, has been actively engaged in disaster preparedness and response activities. This response includes community mobilization, capacity building, coordination, assessment and relief and recovery projects. General Body, Board of Directors and senior management of SPO have also contributed intellectually through writings, talk shows and policy inputs.

Chief Executive of SPO Mr. Naseer Memon has been regularly writing articles in national newspapers on various dimensions of the climate change and disaster. We are pleased to publish this book which carries Mr. Memon's articles on this subject. We are sanguine that this modest contribution of the author and the organization will be a useful reference for civil society, decision makers and advocacy groups.

**Dr. Tufrail Muhammad Khan**
Chairperson
Board of Directors, SPO

# Foreword

It is said, “Coming events cast their shadows before.” Scientists of the world, in government as well in private, under the umbrella of Inter Governmental Panel on Climate Change (IPCC) have confirmed that the climate of the Earth has undergone a significant change over the last 150 years or so. The most significant manifestation of this change is Global Warming i.e. rise in temperature of Earth. According to them, 1990 was the warmest decade and 2005 the warmest year on record since 1860. As a consequence, glaciers are melting/ retreating, sea levels are rising, more frequent storms and extreme weather events are taking place.

There is broad consensus by scientists that this change is a consequence of human activities, primarily burning of fossil fuels and deforestation due to population explosion, industrialization and urbanization. These human activities produce green house gases (GHG) mainly carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($NO_2$) which trap heat inside the atmosphere and warm the surface of earth. It is said that Earth has warmed by $0.74^0$ C over last 100 years. Warmer surface temperatures heat the oceans, melt ice sheets, and alter weather patterns across the globe. As a result sea levels have risen globally by 10-20 millimeters during $20^{th}$ century and snow cover has receded by 10% since 1960, with a 5- kilometer retreat in alpine and continental glaciers. The situation is serious in Arctic where ice cover has retreated faster than the global average and if this trend continues, it is predicted that summers in the Arctic will be ice free within 100 years.

The observations of IPCC are important still but more important are their impacts on human beings. These impacts will create water scarcity, food in security, inundation of island nations with sea level

rise, catastrophes and calamities with extreme climate events, health hazards and adverse impacts on eco- system and biodiversity.

It is observed that impact of any calamity is much adverse if it strikes suddenly. However, if there is awareness and preparedness. Its impact is much reduced. Sindh being the lowest riparian of Indus River System, climate change is going to have a big impact on its water availability due to melting of glaciers, cultivation due to less water, delta due to no supplies of water, coast due to see level rise. Creating awareness about these impacts is like reducing the misery and getting people prepared for calamity.

Mr. Naseer Memon is playing the role of a seer or visionary informing people of Sindh about coming events of climate change through his various articles. The way of informing is simple and straight forward. This shows his love and attachment for this land which is besieged with multifarious challenges. His efforts will much ease the miseries and mortifications of people of Sindh in coming years when these events take place. I congratulate him on this effort.

**Muhammad Idris Rajput**
Retd Secretary
Irrigation and Power Department
Government of Sindh

# Dealing with Disaster

JAPAN is currently wading through the debris of the recent earthquake and tsunami. One of the world's largest economies and a technologically advanced nation, Japan boasts nearly flawless earthquake-proof structures and a highly efficient tsunami early warning system.

What lessons do the Japanese natural disasters hold for a country like Pakistan? A cursory glance would suggest that the occurrence of a disaster of lesser magnitude could simply erase our coastal areas from the map. Some facts leading to such a doomsday conclusion are mentioned as follows.

The Indian Ocean doesn't have a single tsunamograph to receive accurate data on any approaching tsunami. Tide gauges installed in Pakistan are not effective enough to issue timely warnings. The time lag between receiving a warning and evacuation could be fatally small and result in disastrous ramifications.

Pakistan's coast has hardly any scientifically developed tsunami evacuation plans in the public knowledge. Some isolated, localised drills were undertaken through international support agencies, but their efficacy is yet to be tested. Also, the simulation of real-time disaster through mock evacuations is little more than playing a video game. An actual disaster may make short work of all arrangements.

Communities settled along the approximately 1,100km long coast are scantly aware of tsunami risks in their areas. Many would not even imagine that a peacefully subsiding wave may be followed by a mightier one.

Coastal communities, especially those in tiny islands and convoluted creeks, have neither elevated ground nor enough time to escape the tides and are therefore exposed to the risk of being interred in a watery grave should a tsunami strike. Similar would be the fate of thousands of others on fishing voyages, who normally remain incommunicado for several weeks.

Coastal communities are virtually bereft of gadgets to receive early warnings. Many would know about the tsunami only when it is too late. They have hardly any awareness of the measures required to escape the jaws of death. Seldom is anyone aware of the natural warning signs of an approaching tsunami.

The institutions responsible for disaster response are in a shambles. The recent floods exposed the capabilities of disaster management authorities at the provincial and district levels. Communities' evacuation becomes an administrative nightmare during disasters.

Karachi — the largest city — is located on the coast and the present infrastructure and land-use pattern may trigger a disaster of immense proportions. The city's managers don't seem to have learnt from the experience of narrowly escaping passing cyclones in recent years. Other densely populated coastal districts and towns such as Jiwani, Gwadar, Pasni, Ormara, Sonmiani, Badin and Thatta are in the same slumber of ignorance and can be caught unawares if any disaster struck the coast.

The gravity of the risk could be judged from the fact that there are four major faults around Karachi and along the southern coast of Makran. The Makran Subduction Zone, having the potential of generating earthquakes, is among the least studied subduction zones in the world. Normally, an earthquake of over 8.0 on the Richter scale could generate a fatal tsunami in the area.

With most current structures in violation of building codes, a jolt of such magnitude would raze a city like Karachi. Any tsunami in the zone would barely allow seven to 15 minutes for communities to escape on the Makran coast. It may, however, take more than an hour to reach Karachi's coast and cause decimation, if the preceding earthquake and ensuing chaos leaves any neighbourhood standing.

The vulnerability of Pakistan's coast to a tsunami cannot be ruled out. In fact, tsunamis are not an alien phenomenon for Pakistan's coast. On Nov 28, 1945, a great earthquake off Pakistan's Makran coast generated a destructive tsunami in the ocean. Cyclones are another potential threat to Pakistan's coast. There is empirical evidence of increased frequency and intensity of cyclones. According to a report (A Review of Disaster Management Policies and Systems in Pakistan), the coastal areas of Sindh are most vulnerable and exposed to cyclones. Historically, the Sindh coast experienced four major cyclones in a century. However, in the period between 1971 and 2001, 14 cyclones were recorded. This sufficiently indicates the severity of the risk.

Pakistan's coast is, however, blessed with a unique natural shield of mangrove forests to protect against ferocious cyclones and tsunamis. This marvel of nature has a unique root system that can absorb up to 80 per cent of wave energy. No man-made structure can compete with this natural bulwark against disaster. Japan spent $1.5bn to erect the world's largest sea wall in the city's harbour at Kamaishi, yet the city was submerged by surmounting tides.

Research carried out after 2004's tsunami shows ample evidence that those shorelines with mangrove forests suffered lesser damage during the tsunami. Imprudence, however, knows no bounds and Pakistan is at the verge of losing this protective fence. Mangrove

cover along the coast has shrunk to a third of its spread in the 1970s, adding to the risk of disaster.

From satellite-activated early warning systems to elevated ground, Pakistan needs an amalgam of technology, preparedness and proper disaster planning to deal with any future natural disaster. The most rewarding investment would be in community-based risk management. It includes creating awareness in communities about the natural signs of disaster, identifying and developing escape routes and elevated ground and training volunteers on how to manage disasters.

Daily Dawn-19th April 2011

# Managing Disaster

PREDICTIONS about this year's monsoon season are ominous. The forecast of 10 per cent higher than normal rainfall in the country's upper catchment areas should set alarm bells ringing.

With the ghosts of last year's floods not yet laid to rest, the incomplete rehabilitation of flood-protection infrastructure is a major cause for concern. Sindh, which was the worst affected by the floods, has yet to complete almost 40 per cent of the repair-work at a time when a premature monsoon has already set in. Punjab and Khyber Pakhtunkhwa have completed more than 80 per cent of the repair work but the predicament of Azad Jammu Kashmir causes consternation since hardly any repair work has been executed. The institutional and administrative web responsible for managing floods was exposed last year as being in shambles. From rescue to relief, every effort was poor enough to merit worry this year.

After the report presented by the judicial commission formed by the Supreme Court, another report by a similar committee formed by the Punjab High Court has laid bare the inefficiency of the flood-management systems in the country. The key findings of both reports are the same. Administrative failure on part of the provincial irrigation departments, rampant corruption, criminal negligence and encroachments in the flood plains have been identified as the reasons that Sindh and Punjab saw such a disaster. A careful review of the judicial commissions' reports reveals that the country does not have an integrated flood-management system. Scattered and disjointed measures may bring temporary relief but they are far from sufficient to thwart any future disaster.

Disaster management includes three key components: risk-reduction, preparedness and response. In Pakistan the first point hardly receives any serious attention, the second component is inadequate and the third is in shambles. The most challenging yet rewarding phase of risk-reduction should be made a priority. While structures are of utmost importance, risk-reduction should not be restricted to the level of mere engineering. The stereotyped conceptualisation of risk-reduction in Pakistan does not conceive of anything beyond flood-protection infrastructure. Additionally, more often than not, it glosses over the social, institutional and biological measures that can be taken. These are the areas where public policy has to be improved. The strengthening of disaster-management institutions and their integration with other relevant bodies is of paramount importance. The Punjab judicial commission has underlined the importance of developing an integrated flood-management plan.

While the judicial commissions' reports substantially capture the gaps in administrative governance, they have almost skirted the nexus of political governance. It is a well-recognised fact that after the police, the irrigation department is a highly politicised area. Since power politics in Pakistan is dominated by a Byzantine alliance of landed aristocracies and urban oligarchies, water is the 'open sesame' mantra for political powers. The posting of grade-17 and 18 officials in the department is directly governed by the irrigation minister and the chief minister respectively. The plum posting is allegedly traded at rates of up to Rs2m. If the custodians of the Tori dyke were of junior grades, their being posted there is not merely administrative brushwork; in fact, it is deeply entangled with political decision-making.

Another example is wilful negligence in terms of the state of the Tori dyke. The Supreme Court's commission has made the startling revelation that on Feb 4, 2010 — i.e. six months before the breach

occurred — it was noted in a meeting of the Indus River Commission that unless the dyke was strengthened well before the year's flood season, the likelihood of colossal losses could not be ruled out. Why was no follow-up work done to allocate the resources required to shore the structure up before the rains started? Can the political leadership be exonerated for its failure in this regard?

Similarly, the network of illegally erected dykes in the floodplains is not a corollary of merely administrative neglect; it is a business that is patronised by local politicians. The same can be said of the occupation of forest land in floodplains. A string of local feudals, administration officials and politicians has let this happen. The judicial commission rightly recommended that strict action be taken against irrigation department officials but it has largely ignored the delinquencies of the feudal and political leaderships. If nothing else the provincial governments should have been asked to disclose a list of people who have occupied vast swathes of land in the katcha areas. The reasons behind the posting of junior and inexperienced officials in the irrigation department could have been made public. This would have exposed the nepotism which resulted in inflicting excruciating damage on the poor.

Another omission is the faulty engineering infrastructure. The interesting dimension of last year's flood was the abnormally long travel duration of peak flows between barrages. The flow that normally takes 24 hours from the Guddu to Sukkur barrage took 33 hours. Similarly, the time-lag between Sukkur and Kotri was an astounding 408 hours as against the normal time-lag of 72 hours. This was partially because of sustained inflows from upstream. However, the role played by newly-built structures such as bridges needs to be delved into more deeply. Structures have been erected on the River Indus without an environmental impact assessment

being undertaken and there is a possibility that these may have aggravated the floods.

All these questions need to be answered so that immediate steps can be taken to mitigate the effects of any flooding this year.

The country cannot afford to do nothing, waiting for disaster to strike.

Daily Dawn-14th July 2010

# Root Causes of Floods

THE flood inquiry commission formed in the wake of the 2010 floods, under the Supreme Court's directive, has unveiled that a major cause of the devastating breach of Tori dyke was brazen negligence by the irrigation department.

The report acknowledges that most embankments are not being maintained properly under standard operating procedures.

Earlier inquiries revealed that senior officials responsible for flood management had not even read the manual. Likewise, the president's parliamentary committee on the monitoring of repair and rehabilitation of Sindh's irrigation works conceded that the dykes damaged by last year's floods cannot be fully repaired by the targeted timeline.

The work was initially delayed due to relief operations and later because of procedural delays in the approval of schemes.

The provincial government proposed 76 schemes costing an estimated Rs14bn to repair various dykes. However, the federal government provided only Rs5bn. Resultantly, the province was constrained to repair 41 high-priority sites to avert further disaster. Such is the bureaucratic procedure that only 17 per cent of the targeted work has been completed so far.

The fact that needs to be considered is that the repair and upgradation of dykes will not in itself guarantee full safety against even floods of lower intensity. Historical data of floods in Sindh indicates that last year's floods were not unprecedented in terms of their magnitude; however, the scale of the disaster was.

The Indus witnessed floods on a similar scale in 1973, 1975, 1976, 1978, 1986, 1988 and 1992. Clearly, the breaches of the dykes were not the sole cause of the devastation. In fact, the root cause of last year's catastrophe was the irreversibly altered regime of the river. The sustained flow of 1.1 million cusecs of water for 11 days at three Sindh barrages corroborates the fact that the obliteration of the river's regime has altered the flood pattern.

If the real causes are not addressed, the treatment of the physical infrastructure will leave the problem only half-solved.

That is not to deny that the repair of the crumbled infrastructure should be the top priority, yet failing to contemplate other dimensions would amount to lack of prescience.

Three key factors would determine the scale of future floods in the Indus river basin — climate change, deforestation in watershed areas and flood plains, and tampering with the river's regime. If these long-term issues are not addressed, the Indus river basin will remain under the perennial peril of disasters, oscillating between drought and flood cycles. The unpredictability of weather is an attribute of climate change. Considering that the problem has no localised solutions, adaptation is the only option. This involves a mixture of biological, social and technical responses. Alterations in flood plains through climatically insensitive engineering works have introduced an irreversible distortion in the river regime to which floods are a sequel.

In the years before Tarbela Dam was built, Sindh would receive a flood of 300,000 cusecs almost every year — and 500,000 cusecs in a number of years. This flood pattern shaped the river regime over the decades and all social and administrative systems were developed in consonance with it.

However, in the post-Tarbela years, high- or medium-level floods became a rare phenomenon. This exposed vast swathes of katcha land for human settlements and agriculture. According to some estimates, approximately 500,000 acres of katcha land is under human settlement in Sindh. The population bulge in settled areas, coupled with a toothless administrative apparatus, has resulted in massive encroachments on the flood plains. Other structures such as bridges and barrages have choked flood plains with obstacles, interfering with the natural stream. Illegal local dykes to protect agricultural activity on the flood plains has also disturbed the river and caused it to swell with high waves near flood-protection embankments.

Since flood disasters are seldom examined from these aspects, most of the discourse is confined to administrative failures, cloaking the fundamental causes of the cataclysm. Before embarking on further engineering solutions such as big dams, the impact of existing engineering structures should be studied. Climate change can potentially render most engineering solutions antediluvian very soon. The conventional approach of solving problems through complicated solutions will only aggravate the situation. Prudence is required.

Pakistan's once enviably well-managed watershed apparatus is now in ruins. Unbridled deforestation in the upper reaches and in the plains of Sindh and Punjab has deprived the river of its wave-absorbing shield. Pakistan is amongst those countries that have the lowest levels of forest cover. According to some estimates, the country loses some 66,718 acres of forest cover annually. Approximately 5,683 acres of riverine forest is lost every year. Riverine forests not only retard the momentum of floods, they also stabilise the riverbed and river banks.

In recent decades, these forests have been erased by the timber mafia in hilly areas and by land grabbers in the plains. In Sindh and Punjab, forests were systematically chopped down to clear land for agriculture and new settlements. Any serious effort to regenerate the lost forest does not seem afoot either. Yet a flood plain bereft of forest cover will remain susceptible to floods.

While taking the short-term steps, the government ought to mull over long-term remedies too. The Himalayan glacial ecosystem is negotiating its way through a climatic onslaught and increased melting is likely to generate even more ferocious floods in the catchments of Pakistan, India, Bangladesh and Nepal. This merits the consideration of integrated solutions.

Daily Dawn-21st June 2011

# Unnatural Causes of Disaster

There is a need to comprehend the role of institutions that exacerbated the impact of the recent floods. Many still see these floods as a prelude to the worst. Without indulging in speculations one can safely say we ought to be equipped to respond to the vagaries of nature.

In August, Pakistan received more than half of its monsoon downpour during one week, which would normally have taken three months, and the flooding this year went on for abnormally long durations.

In Sindh, three barrages had to face a furious flow of over 1.1 million cusecs for almost eleven days. This lunacy of flood is a clarion call from nature that we seriously need to realign our response mechanism in order to be commensurate with such somersaults of climate.

The recent experience of disaster response mocks at our administrative adequacy. The institutional tentacles of our disaster response system were practically paralysed by the enormity of the floods. The National Disaster Management Authority (NDMA) and its provincial and district extensions were sent into a tailspin by the disaster. PDMAs and DDMAs proved to be quite ineffective.

In disaster response, the lowest tier i.e. the DDMA, is of paramount importance by virtue of being the first and the last line of defense for communities. The DDMAs, under Section 21 of the National Disaster Management Ordinance, are charged with devising disaster management plans for their districts; but hardly any were in place. Certain international donor organisations provided

technical and logistical support for capacity-building of selected DDMAs in the country, but provincial governments seldom considered institutionalisation of PDMAs and DDMAs as serious business. Though DDMAs are under the administrative control of provincial governments, yet there were instances when they were reprimanded by the NDMA if they approached any donors for any support. PDMA in Sindh is manned by less than a dozen staff members at Karachi without any outreach stations in the rest of Sindh.

Punjab, till recent days did not have any PDMA at all, and those established in the remaining provinces lacked agility because of the dearth of human, technical and financial wherewithal. Our shoddy disaster management machinery was soon on its knees as the disaster unraveled the patchwork of dykes built to hold the water back.

But, bemoaning aside, lurking catastrophes in the future demand serious investment in disaster prevention and response systems. DMAs at all levels need much serious attention now to improve their systems, and infuse sufficient human, technical and financial resources.

Ideally, DDMAs should also have extension at *tehsil* and union council level. However, this is not to suggest that more echelons of bureaucratic strata should be invented; rather, a more action-oriented, grassroots based, truly participatory organisational structure that can nimbly respond to calamities, must be put in place. In its current structure, DCOs are the embodiment of DDMA, and most of them have little capacity for disaster response, which demands a well defined coordination mechanism of various entities at provincial and district levels.

Disaster/hazard mapping would be the bedrock of a workable disaster response system. Regrettably, this very fundamental has yet to see the light of day; in absence of which all the rest becomes a hotchpotch of reactions when a disaster occurs.

Creeping disasters like land degradation, top soil erosion, watershed mauling due to rampant deforestation, pollution of fast dwindling water resources, the weakening coastal eco-system and the cross-contaminating urban air are mistakenly considered subtle threats, as they don't send shockwaves of horror. But unless this country has an all-encompassing disaster map, planning and preparedness would remain a mirage.

Lack of appropriate early warning systems has been a major cause of otherwise preventable localised disasters. Timely warning is the linchpin of any disaster response mechanism as it can assuage the impact to a considerable degree. The Flood Map of Pakistan is devoid of any network of localised or integrated early warning web. With the exception of Nullah Leh in the twin cities of Rawalpindi and Islamabad, the system is nowhere heard of. An early warning system is particularly critical in spate flow areas of hill torrents, where high intensity flows can easily outpace evacuation efforts. During the recent floods, torrents from Koh-e-Suleman knocked communities without any warning in South Punjab. In 2007 when the Yeymin cyclone smacked Balochistan, cloudburst in its catchment areas caught western districts of Sindh unguarded because of the absence of an integrated early warning system in the Khirthar range.

In managed rivers, however, forecasting a flood becomes easier, although our prevalent system is too primitive by contemporary touchstones. Telemetry system could have offered some respite, but the same was not allowed to function by unscrupulous elements that thrive on data juggling. An aftermath of that was

witnessed in defective preparedness in Sindh where initial flood estimates of 0.8 million cusecs proved a mere ruse, leaving the province misinformed.

An initial relief breach in Tori bund wreaked havoc in the province, and the upper half of Sindh from Kashmore to Dadu/Jamshoro had to pay the cost. The flood debacle in Sindh has unmasked the fragility of governance structures where individuals dominate the rules of business.

A trust deficit between the federation and the federating units has been a major source of relentless divisiveness on this issue. Only a few days after the floods had ruled the canals, riparian provinces were exchanging barbs on opening of the Chashma-Jehlum link canal. According to a leading national daily, the FFC reports showed an increase of 331 percent in the number of flood affected people in Punjab by inflating the number from 1.9 million given in its 20th August report to 8.2 million on 1st September. The data managers at FFC overlooked the fact that the number of affected villages, households and acreage remained unvaried in both reports. Likewise, the report inexplicably reduced the number of cattle head killed in Sindh from 129,416 to 24,788.

This numerical nonsense race was stemmed only by the sheer lack of credibility expressed by the people in the attempt made by system prodding stakeholders to inflate the figures in order to grab a bigger share in the aid pie. The experiences from this disaster can become a strength if we can harvest some learning for future years and fortify our institutional systems in a prudent manner.

The News-19th September 2010

# What Worsened the Flood Disaster?

Malevolent rivers this year brought unprecedented disaster in all provinces of the country. From the rickety civil infrastructure to the shabby administrative web everything has been washed away by the horrendous disaster. The present flood has emerged as the most devastating manifestation of natural disasters on earth. According to Douben, Ratnayake, half of the 367,000 people who lost their lives to natural disasters between 1986 and 1995, were victims of storm surges, river floods or flash floods. From 1998 to 2002, the world witnessed 683 flood disasters with 97% of these visitations occurring in Asia. The trend clearly points towards doomsday projections for the years to come, and calls for a tectonic shift in current practices of disaster management in vogue in countries like Pakistan.

The Indus River that wrought the major havoc in parts of Punjab and Sindh provinces is still tormenting human settlements, and its fury is set to catapult more during the left over rains of the monsoon season. Both natural and human factors triggered this devastation. According to Professor Martin Gibling of Dulhousie University, the Indus was even mightier during a warm period some 6,000 years ago. Then, 4,000 years ago as the climate cooled, a large part of the Indus dried up and deserts replaced the waterways. The Processor points a finger towards the localized warming phenomenon as being the element responsible for the disaster. In his opinion, monsoon intensity is somewhat sensitive to the surface temperature of the Indian Ocean. During the time when the climate is cooler, less moisture is picked up from the ocean, the monsoon weakens and the Indus River flow is reduced. In this

backdrop, climate change seems to be a major factor behind the pathologically insane monsoons this year.

The non-reliability of historic data regarding the threat posed by climate change often renders all estimates redundant. Khyber Pakhtunkhwa experienced a unique monsoon this time, which has hardly any precedent in the past. No analysis of historic data could have foreseen what was witnessed in the recent weeks. This episode is actually even more alarming when it is considered that anything unexpected hitherto may happen any moment anywhere, with greater severity than imagined. The higher degree of weather unpredictability because of climate change is a real challenge for the already fragile flood management systems in Pakistan. Extreme and unpredictable weather conditions are likely to make disasters a moving target, making it near impossible for flood managers to respond to such disasters with the given capacity.

Along with several factors responsible for making the disaster excruciatingly difficult, the absence of localized early warning systems, ineffective disaster management paraphernalia, virtually non-existent integrated flood management plans, and a system bereft of proactive planning to mitigate disaster impact need to be closely examined. The disaster has exposed the capacity gaps of the agencies responsible for disaster management, particularly at provincial and district tiers.

While all provinces have faced devastation, a report of the Federal Flood Commission issued on 20$^{th}$ August reckoned that Sindh was the worst hit, as 3.68 million of the 7.71 million flood affected people, and 211,375 from a total of 303,698 houses battered by the floods were located in Sindh. Similarly, Sindh's share of affected villages came to 4,359 out of a total of 11,027, and 1.55 million acres out of total of 4.70 million acres of cultivated land was inundated by the sheets of water. Sindh government's latest

statements put the toll of affectees to over 7 million people. In all likelihood these digits will swell and would paint an even more somber picture with every passing day. With a little less severity, disaster in Pakhtunkhwa and South Punjab has also left deep scars on communities.

There is no dichotomy of opinion that the scale of the disaster would have outdone the response in any case, yet the miseries could have been much less had certain best practices of disaster management been in place. In Khyber Pakhtunkhwa, the Peshawar Met office could not transmit the timely warning of the predicted abnormal showers only because the fax machines in the DCO offices of Charsadda and Nowshera were not working properly. Likewise, the initial estimates of flood at Sukkur barrage were derided by the actual flows that made the Sindh government manic, ultimately leading to enigmatic decisions of breaching bunds, railway tracks and roads to ease pressure from the barrage structures and certain strategic locations. A shadowy decision making process has sparked another controversy that may eventually snowball to a full blown conflict.

A comprehensive GIS based flood management plan would have more precisely determined the potential sites for breaches to prevent major losses. However, the media reports suggest that the murky decisions were taken at the spur of the moment, presumably influenced more by politics than any informed process or institutional mechanism. The breaches in Tori and Ghouspur bands in Sindh actually triggered the worst disaster, enveloping vast areas in north Sindh and rendered several hundred thousand shelterless. As a result, the districts of Kashmore, Jacobabad, Shikarpur and Qambar-Shahdad Kot are witnessing their worst human crisis in known history. The worst part was inadequate evacuation notice and unavailability of transport, which made migration intractably difficult. More than seven million people have lost their abodes and

source of livelihood, and have endured a traumatic experience, the spook of which will haunt them for rest of their lives.

Ignoring the very fact that a flow of 10 million cusecs would have spilled over any dam of the size of the proposed Kalabagh dam, a clamor was raised that it was merely the absence of large dams that has caused this disaster. No engineering or flood management science would substantiate this argument. Sukkur, Guddu and Kotri barrages braced a flow of one million cusecs for nearly ten days. Any such dam would not have had the capacity to absorb this massive flow. It would have rather made the very dam structure vulnerable to bursting at the seams and to potentially multiply this catastrophe manifold.

Coinciding with the floods in Pakistan, China also faced the wrath of floods and at one stage hundreds of soldiers were deployed to prevent a likely disaster; if the Wenquan reservoir had burst it could have inundated Golmud city and its more than 200,000 population under a four meters deep wave of water. In this very year the North-East of Brazil, known for droughts, witnessed a devastating flood killing 50 people and leaving 150,000 homeless. The devastation was mainly caused by the bursting of dams on two rivers. In March 2009, a dam that burst near Jakarta killed scores of people. In fact the damming of rivers has made drastic alterations in the natural flood plains of the Indus, and the consequent contracted trachea of the river Indus is also a major cause for the horrific intensity of the flood. A series of dams and barrages have led to excessive siltation in the riverbed, thus elevating the surge to dangerous levels. Entropic human settlement patterns has been another cause of large scale displacement. The mass exodus from the flood plains as a result of the floods highlighted the fact that unregulated human settlements were responsible for making the scenario further bleak.

Rampant damming and diversion during past decades has changed the flood regime entirely, and vast tracts previously part of the flood plain was exposed as dry land, which encouraged new settlements. Before the Tarbela dam was built, the Katcha area of Sindh received a flood of 300,000 cusecs almost every year, and a flood of 500,000 cusecs for 77% of the years recorded. The Tarbela and other barrages completely altered the flood pattern, leaving large parts of the flood plain barren, and thus paved the way for dense human settlements in the strips flanking the river course. According to a report, some 50,000 acres of Katcha area is under settlements, with roads and government structures. The decades long ignored physical planning of rural areas and skewed development pattern forced the marginalized rural communities to seek recourse to ribbon development along the river banks. Dwellers of such areas were noticeably more resistant to evacuation, as their asset base was tied to the flood plains. Furthermore, unbridled deforestation partly due to lack of regular flood flows and partly due to avaricious elements in politics and bureaucracy also aggravated the flood impact. The absence of thick forest that could have absorbed considerable wave energy compounded ferocity of the flood.

There is a risk of impending social disaster if the rehabilitation and reconstruction phase is not designed and executed with transparency and with the participation of various segments of society, especially civil society organizations and the private sector. Avoiding such disasters in future needs long term integrated planning along with a committed and competent execution mechanism. Political will would be the cornerstone if it happens at all.

The News-5th September 2010

# Bumpy Road to Rehabilitation

Floods have now receded, leaving a trail of devastation behind. Deep scars of this disaster would take years to heal. Although relief phase is yet to end but concomitant to that more arduous phases of early recovery and rehabilitation can't afford any delay. The camp life ordeal of affectees would soon get over yet their suffering would only change its form as they return to their uprooted abodes.

Early recovery typically requires rapid assessment that may help initiating a transition from life saving to life sustaining activities in the affected areas. This phase entails issues like resettlement, livelihood restoration, rebuilding of basic infrastructure and planning for effective rehabilitation phase. The major challenge in this phase would be the magnitude of physical disaster. The scale of mammoth challenge can be gauged from the damage data. According to NDMA's update of 23rd December, over 1.9 houses are damaged in the country. Sindh province appears to be the worst hit accounting for over 1.1 million damaged houses.

Estimates of infrastructure such as roads, bridges, government offices, culverts do not appear in this report. However, various other reports provide information on these aspects. A report of UNESCO puts the number of damaged schools to 10,000 that corresponds to 1.5 to 2.5 million students affected. Punjab government's initial estimates reckon the damages to the tune of Rs67 billion. Website of PDMA Sindh shows staggering damage estimate of Rs446 billion.

Sector-wise breakup shows housing and agriculture as the worst-hit sectors in Sindh with estimates of Rs134 and 122 billion

respectively. Secretary Industries Department of Sindh has confirmed that 67 industrial units in Sindh have been damaged. Similarly the Sindh Agriculture Department estimates agriculture losses at 102 billion rupees. A report of the UNOCHA on 10th August mentioned that 281 bridges and 283 roads were affected in KPK. Balochistan fretfully decried underestimation of its damages. In the long and short, volume of damages is mind-boggling and that explains the lurking ramifications of the bumpy road to rehabilitation. Putting together federal cabinet was informed that the colossal losses are estimated to US$ 43 billion, nearly 25% of the nominal GDP of Pakistan.

Early recovery in the affected areas would demand greater focus on agriculture and its extended strands of livelihood. Since most of the affected areas, specially in Punjab and Sindh, have their economy embedded in agriculture, immediate attention is required to secure winter sowing, mainly wheat that guarantees staple diet for millions of households. Any laxity in this would precariously push the rural economy and livelihood to the brink of collapse that may eventually culminate into a perilous social chaos. To avert this risk, government will have to work on a war-footing mainly for dewatering of submerged swathes, repairing field channels and regulators and mobilising seed, fertilizer and other inputs.

Paucity of supplies would skyrocket prices, initially of inputs and subsequently of commodities. Efficient management of winter crop would partially assuage the miseries for affectees as the local economy would get a shot in the arm with good harvest. This would bring respite for the edgy government and rehabilitation phase would also become less turbulent.

Rehabilitation phase is targeted to restore life to pre-disaster stage. This stage has to focus both on individual affectees and public services. Many experts of disaster management consider

rehabilitation as an opportunity of better rebuilding through ameliorated planning, infusing socio-economic reforms, redefining imperatives of rural economy and reconstructing infrastructure as disaster-resistant and environmentally sustainable.

Rebuilding major infrastructure and reshaping socio-economic vista require meticulous planning and a turbocharged institutional array to make this transition wrinkle-free. The Independent Evaluation Group of the World Bank has also indicated in its report that Pakistan has a unique opportunity to introduce land and irrigation reforms for long term political and economic gains. The report suggests that the disaster also presents an opportunity to redress or to begin to redress, the long-standing land rights issue related to powerful landlords and indebted tenants in areas like Balochistan, Sindh and Southern Punjab.

Likewise, better land use planning can help rebuilding environmentally sustainable human settlements. Stemming from shear lack of land use planning, villages and towns in Pakistan have become breeding grounds for social strains and environmental nightmares. Unbridled sprawl of villages and towns have completely disregarded the fundamentals of development. Over the years major infrastructure schemes were implemented in the flood prone areas.

A vicious web of private dykes, illegal irrigation channels and other imprudent creatures was recklessly allowed to sneak into the flood plains. How this environmentally myopic development multiplied the damages need to be delved. Rehabilitation phase is a heaven-sent opportunity to rectify these gaffes. Land reforms, especially judicious allocation of katchha land and recovering illegally occupied tracts of riverine forest would be the best harvest of this worst disaster.

The insurmountable challenge, however, would be convincing the ruling elite to let it happen unhindered. Since the fragile democratic dispensation stands on the crutches of unscrupulous landed aristocracy, such reforms look like a distant dream. Otherwise erasing social imbalances would provide bedrock foundation to democracy in Pakistan. The major challenge in rehabilitation would be resource mobilisation. Ever bulging security cost has hemorrhaged the cash-strapped government from its residual liquidity. According to newspaper reports the federal budget has recently been defaced by major changes into defense and development allocation. The former has been allocated additional Rs110 billion and the later has been drained by Rs73 billion, leaving development kitty in pallor.

Council of Common Interest announced a compensation of Rs100,000 for every affectee family but the provinces are too impoverished to afford this. The Advisor for Planning and Development in Sindh has already conceded that the slim purse of the province can't afford 190 billion rupees required for the purpose. The international aid response had been sluggish due to medley of reasons. The UN has launched "Pakistan Floods Emergency Response Plan" seeking US$ 2 billion. The plan aims to provide humanitarian relief and early recovery assistance to up to 14 million people through 483 projects. The anemic treasury needs aid injection to foot the rehabilitation bill that would run into several billion dollars. There is a need of massive public sector investment to reinvigorate the caved-in economy in the affected areas.

This investment, however, should not be restricted to dole outs; it should rather follow the 'New Deal' paradigm of socio-economic recovery of US after Great Depression in 1930s. President Roosevelt declared it a peacetime emergency and established Federal Emergency Relief Administration that pumped money in "work

relief" operations. Huge projects of roads, bridges, schools and other public works were rolled out that generated jobs for 4 million citizens.

Such a model would proffer multiple benefits of rebuilding public services, rejuvenating the tormented local markets and creating much needed employment for affectees. Creating exclusive small and medium enterprise corridors in urban areas fueled through soft loans would also help affectees to recuperate from crisis. In presence of heavy debt servicing and ballooning defense expenditure, little is left for public sector development, which complicates the dilemma of civilian governments. Considering these harsh realities, rehabilitation phase immediately requires an all encompassing master plan before rolling out muddled development schemes. The plan may comprise short term, medium term and long term targets coupled by a strategy to mobilize resources and efficiently investing them to achieve strategic socio-economic gains.

The News-10th October 2010

# Climate Change and Future of Large Dams

Climate Change is no more a fiction but a challenging reality for thinkers, planners, professionals and decision makers in today's world. In fact decision making on development projects would no more be valid unless it takes climate change into account. Countries like Pakistan where economy, social fabric and politics are directly linked with irrigated agriculture, water resources are at the heart of most of the conflicts. Although industry and service sector have also emerged as important contributors of national economy, yet agriculture still dominates the socio-economic horizon and will continue to dominate in the foreseeable future. Hence availability and reliable supplies of water are the key factors to shape the national economy.

Possessing one of the largest and most inefficient networks of irrigation, Pakistan faces a complex challenge of managing water resources. Conflicts on water distribution at head and tail of water courses are frequent and across the provinces are older than the country itself. Construction of series of dams, link canals and barrages has caused deep rooted mistrust among stakeholders. This has been worsened by non-professional attitude of water managers coupled with ceaseless corruption and institutional inefficiencies. This is the picture of the times when climate change has not yet unfolded its consequences with full might. It's every ones guess, how the picture would look like once climate change ushered with its multifarious impacts.

Over past three decades construction of new dams on Indus River system has particularly been a major source of conflict between the upper and lower riparian. The lower riparian Sindh province has been strongly opposing new dams on Indus. One major argument of Sindh against the big dams has been socio-environmental impacts on the province especially on flood plains and delta. Technocrats, politicians and civil society of Sindh also argue that the Indus River System does not have enough flows to divert for storage and that may ruin economy and livelihood of people in the province. Anti Kalabagh dam and Greater Thal Canal movements have specially influenced political scenario in Sindh during the recent years. Environmentalists in Sindh specially refer to massive degradation of riverine forest and mangroves eco system in Indus delta. Almost ten years back, Sindh government officially acknowledged that sea intrusion has occupied over 1.2 million acres of land in delta. Environmental degradation in Indus delta is so conspicuous that even pro-dam lobbies can not deny it. Likewise riverine katchha (flood plain) of Sindh has lost its prosperity due to depleting flows in Indus. Forest, fisheries, agriculture and livestock had been traditionally supporting rural economy of Sindh. Lack of floods due to upstream diversions have ruined this prosper economy and increased poverty to alarming levels in rural Sindh. This has also degraded precious fresh water lakes in Sindh, which provided livelihood to hundreds of thousands of people. The situation is bound to aggravate with Climate Change.

A basic misunderstanding about climate change is that it is mere rise of temperature, which is the truth in part. The actual problem with the phenomenon is unpredictable behavior of climatic manifestations such as precipitation, average temperatures etc. Climate patterns take centuries to set in. Agriculture planning is particularly dependent on the degree of accuracy of weather prediction. Frequency and quantity of precipitation has to define the water resource planning and management. It not only helps

planners and decision makers to make appropriate water allocations for various parts of country at different timings but also helps farmers in determining suitable cropping pattern in their areas. In addition to that water management infrastructure is also designed and regulated on the same basis. Indus River is well known for its erratic flows and if climate change makes it even more unpredictable, the whole water engineering and management would merit cautious revision. Regrettably the water bureaucracy of the country does not seem to be cognizant of the climate change factor. For example Water Vision 2025 of WAPDA does not take climate change into consideration. WAPDA is planning to add 10,000 Mega Watt hydro power through five mega projects by 2016. Estimates for these projects are around 20 billion US Dollars. These include Bhasha, Kalabagh, Akhori and other dams. WAPDA has not even the remotest sense of climate change impact on these plans. While Tarbela and Mangla dams are already loosing their capacity owing to heavy silting, newly envisaged dams are bound to meet the same fate as climate change has to result in generating even greater amounts of silt from Himalayas in the coming years.

Most of the flows of Ganga, Indus and Kabul rivers are generated by melting of snow from Himalayas which occur mainly during summer. Whole life cycle of people and their livelihood in the region is dependent on flow pattern of these rivers. Agriculture being major source of livelihood and economy has to suffer in case of variations in flow patterns. Unpredictability resulting from climate change on Himalayas' snow buildup or melting will have profound impact on these basins. According to "The Melting Himalayas", a research report issued by the International Centre for Integrated Mountain Development (ICIMOD) "the Himalayas region, including Tibetan Plateau, has shown consistent trends in overall warming during the past hundred years. Various studies suggest that warming in the Himalayas has been much greater than the global average of 0.74 degree Celsius over the last hundred

years. Many Himalayan glaciers are retreating faster than the world average and are thinning by 0.3-1.0 m/year. The rate of retreat for the Gangotri over the last three decades was more than three times the rate during the preceding 200 years. Most glaciers studied in Nepal are undergoing rapid deglaciation. In the last half century, 82 percent of the glaciers in the western China have retreated. On the Tibetan plateau the glacial area has decreased by 4.5 percent over the last 20 years and by 7 percent over the last 40 years." This trend of glacial retreat clearly indicates that the rivers receiving their flows by snow melting will experience higher flows for initial period followed by continued decline. According to the same report, various climate change scenarios will have varied impacts on flow pattern. "One concludes that with a two degree Celsius increase by 2050, 35 percent of the present glaciers will disappear."

It does not need brains to conclude that flow patterns in major rivers fed by Himalayan melting would become more erratic in the years to follow. Typically designing of dam takes into account historical flow data and assumes that almost the same will be maintained in the subsequent years. This assumption will no more be valid due to climate change thus questioning the basic equations of dam feasibility. A report of ICIMOD mentions that the temperatures on Indian sub continent are likely to rise between 3.5 to 5.5 degree Celsius by 2100. Extreme weathers are likely to occur due to climate change. In case of unpredictably higher floods, the dam safety would be the biggest challenge as dams are designed to withhold certain peak floods. In exceptionally high floods, the dams can either burst or their backwaters may inundate areas outside its water boundaries. In both cases loss of life and property can attain horrible proportions. Defrost and heavy flows will bring more debris and can reduce the dam life by accelerated silting. Himalayas are young mountains and their rate of erosion is very high. Changes in precipitation pattern will have impact on silt flows in rivers. Warsak dam was completely silted and the Tarbela and Mangla are told to

have lost almost one third of their capacity. Who can guarantee on earth that the new proposed dams would not meet the similar fate? Technical Paper VI "Climate Change and Water" of Intergovernmental Panel on Climate Change also highlights this fact. It reads "Generally the frequency of occurrence of more intense rainfall events in many parts of Asia has increased, causing severe floods, landslides and debris and mud flows (P-86)."

Similarly low flows and droughts will also question the justification of investment of billions of dollars if the dams remain underperformed. Construction of new dams promises to bring more land under plough which requires additional investment in extension of irrigation network and land development. If the dams could not deliver what they promised, the whole investment will end up in generating new conflicts. Considering the above facts it would be reasonable to conclude that huge investments on dam structures will be at risk in the context of climate change. Miller, K.A, S.L. Rhodes and L.J. Mac.Donnel suggest in their document "Water allocation in a changing climate: institutions and adaptations" that "Water infrastructure, usage pattern and institutions have developed in the context of current conditions. Any substantial change in the frequency of floods and droughts, or in the quantity and quality of seasonal timing of water availability, will require adjustments that may be costly, not only in monetary terms but also in terms of societal and ecological impacts, including the need to manage potential conflicts between different interest groups.

Since Pakistan is located in a region prone to severe climate change impacts, it would be pertinent to recommend that whole water sector management regime should be revisited in the light of climate change phenomenon. Climate change will have significant impacts on water resources in the region therefore all water engineering projects need to take this new dimension into account.

Projects like large dams on Indus River System need a thorough understanding and research on climate change impacts before embarking upon. This may call for searching more viable options of water conservation.

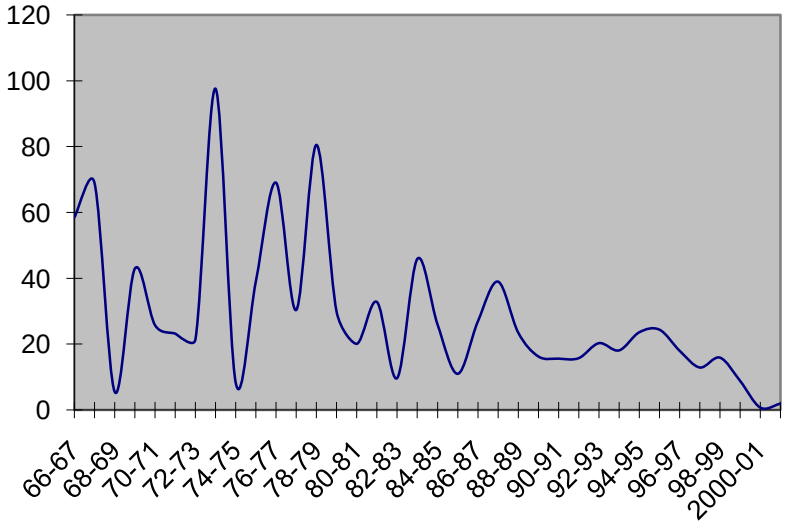
Daily Dawn-9th March 2009

# Climate Change and Disaster in Indus Delta

Sindh Assembly in a recent session adopted a consensus resolution demanding from the federal government to take urgent steps to check sea intrusion in coastal districts Thatta and Badin. Conservation organizations, Environmentalists and civil society have been highlighting the plight of coastal areas of Sindh, however the same has never been given serious attention as the decision makers of the country have been considering flow down stream Kotri as waste. Environmental Flow is an alien concept to our decision makers due to poor environmental literacy among them. Member Sindh Assembly from Badin Dr. Sikandar Mandhro while presenting this resolution revealed that sea has occupied 1.3 million acres in the two districts and it continues to eat 80 acres a day on an average. Six sub divisions of Thatta viz. Ghora Baari, Kharo Chaan, Keti Bunder, Shah Bunder and Jati are the worst hit. These areas were historically prosperous due to extensive agriculture and trade activities. Now these areas are counted among the poorest parts of the country. The drastic change has not ushered over night due to any natural calamity, it has been rather creeping like slow poison and decision makers have been witnessing it with apathy. A significant part of over 2 million people of the two districts have been paying the price of wrong priorities and ignorance on part of decision makers.

The Water Accord of 1991 prescribed at least 10 Million Acre Feet (MAF) water to flow below Kotri barrage to maintain fragile eco system of Indus Delta. However this flow was seen only during high flood years when surplus was to be drained below Kotri any way. In

low flow years, Delta remained thirsty. The flow pattern below Kotri during post Tarbela Dam years (shown in the graph) narrates the gradual unfolding of environmental disaster in Indus Delta.




Annual average flow below Kotri during 1999-2004 was approx 6.8 MAF and during extremely dry years of 2000-2003 it was only 2 MAF. Year 2001 shows the lowest flow which was less than One MAF. In year 2000-01, Government of Sindh officially recognized that 1.2 million acres of land in Thatta and Badin has been occupied by sea. Eight years past with almost similar flow conditions, the amount of land under sea must be much more than 1.2 million acres now. Sea intrudes mainly in three ways. Sea water erodes land and gradually submerges large tracts of land or it may temporarily inundate land during high tide (which eventually submerges the land in years to come) and the invisible form of

intrusion is sub surface creep, which makes the ground water aquifers unfit for human consumption. Several villages in coastal areas migrated mainly because their aquifers became non-drinkable. Some independent studies reveal the fact that sub surface intrusion of sea on Sindh coast is even deeper and longer than the surface creep. Technology to monitor the trend of sea intrusion both above and below surface is commonly available, what is not available is sadly the political will.

The most important reason triggering sea intrusion is the shortage of fresh water flows from Indus into Arabian Sea. Fresh water flows into sea has multiple benefits ranging from resisting cyclones and Tsunamis to maintain salinity in estuaries to a level where the eco system can support aquatic life such as fish and mangroves. Due to shortage of fresh water flows, creeks have become inhospitable for mangroves and fish. According to a study "Consequences of sea water intrusion in Sindh" conducted by Indus Institute for Research and Education" creeks of Arabian Sea have become more saline than the sea itself. Salinity in creeks has reached 3.8 to 4.2 percent against 3.6 percent of the Arabian Sea. Salinity of water along the shores of Karachi at present is 35,500 to 36,900 parts per million (PPM) and has increased to 41,000 to 42,000 ppm in back waters and tidal creeks. Draft Final Main Report of "Study on Water Escapages Downstream of Kotri Barrage to Address Environmental Concerns" conducted by Kotri Barrage Study-II Consultant Group in 2005 recommends that at least 15 MAF water should reach mangroves to maintain their present state and improve their environmental conditions. Conservation of this natural eco system creates a natural shield against climate change related natural calamities on one hand and ensures food security for masses, mainly poor (over two million in case of Sindh coast) on the other. Indus delta eco system owes its sustenance mainly to mangroves eco system, which is rapidly vanishing due to drastically reduced fresh water flows into sea. Till late 70s the mangroves cover was

approximately 260,000 hectares, which reduced to 160,000 hectares in early 90s. Studies conducted by WWF put the figures to a shocking low of about 80,000 hectares in 2001.

As no physical monitoring of this disaster is being carried out therefore impact monitoring becomes a far cry. How it would have impacted lives of millions of mainly poor communities in coastal areas; does not probably even feature in the information menu of our decision and policy makers. Upstream beneficiaries of diversion of Indus water do not even consider coastal communities as affectees of the large projects of water sector. People displaced from construction site are generally considered as affecttes for compensation. In fact the communities in delta pay even higher price of these projects and they have to share larger part of sufferings resulting from water diversion projects. However project implementing agencies never considered delta people as affectees. After the country came into being, a number of huge water sector development projects including two big dams Tarbella and Mangla along with Jinnah, Kotri, Marala, Taunsa and Guddu barrages have been implemented without taking into consideration of their potential impact on downstream areas. While projecting figures of crops and electricity generation as benefits of dams and barrages, there is hardly any study which can comprehensively determine the level of damages resulted from these projects. People in flood plains of Sindh (Kachho area) and downstream Kotri have lost their livelihood and poverty is at its highest in these areas

Data of post Tarbela dam shows steady decline in flow below Kotri except in high flood years when escapage below Kotri was unavoidable. During negotiations between Pakistan and India over water dispute with the assistance of The World Bank, both countries agreed that minimum 17 MAF water has to be discharged into Arabian Sea. This quantity was reduced to mere 10 MAF in 1991 accord. “Study on Water Escapages Downstream of Kotri

Barrage to Address Environmental Concerns" conducted by Kotri Barrage Study-II Consultant Group in 2005 reduced it further to 8.7 MAF. Interestingly the initial draft of the same study recommended 20 MAF flows (including 15 MAF only for mangroves) for Indus Delta. However this figure was later altered to 8.7 MAF due to unknown (but better understood) reasons. Government has been claiming average flow below Kotri has remained 35 MAF. Even if this figure is accepted, the strange outcome is incessant disaster in the Indus delta. Simple logic suggests that even 35 MAF has not helped in improving environmental conditions of the delta therefore that should be considered as the least requirement of flow even if the present level of disaster is accepted to continue. On this basis, environmental improvement of delta needs even higher flows. According to "Consequences of sea water intrusion in Sindh" conducted by Indus Institute for Research and Education" until 1960s land was advancing into sea at the rate of 4 km per century but now the course has reversed and near 2 million acres of land has gone under sea in the matter of few decades. This reflects on the priorities of policy makers. Indus delta originally occupied an area of about 600,000 hectares, consisting of creeks, mudflats and forests between Karachi in the north and the Rann of Kutch in the south. There were 16 major creeks making up the original delta, but due to reduced flows below Kotri, only the area between Hajamro and Kharak creeks now receives water from the Indus, with one main outlet to the sea, Khobar Creek. The active delta is now only 10 per cent of its original area. It would be pertinent to suggest that a comprehensive study should be conducted to assess ecological and socio-economic impact resulted from present dams and barrages before deciding construction of new big dams like Basha.

Climate Change phenomenon is another upcoming challenge bound to complicate the situation further. Since 1850, sea level has risen by 165 mm. According to Intergovernmental Panel on Climate Change (IPCC), the global world temperature has increased by 0.6

$^0$C over the last 100 years and is forecasted to rise further by 1.4 to 5.8 $^0$C before the present century ends. This will trigger melting of glaciers resulting in further rise in sea level. Although it may bring more water to Indus Delta but after melting phase, climate change will bring reduce Indus merely to a rain fed river. It will alter the whole dynamics of economy, environment and life around Indus. This is high time that our decision makers seriously work on possible impact of Climate Change in the country and especially in Indus Delta. Ignoring this fast approaching disaster would have catastrophic implications.

Sindh Assembly resolution demands construction of dikes to stop sea intrusion as an immediate measure; however it would bring only partial relief by stopping surface intrusion. Sub surface intrusion and seepage through dikes would continue unless sufficient flow is not maintained below Kotri barrage.

Daily Dawn-15th December 2008

# Climate Change and Vulnerability of Sindh Coast

Our planet has experienced very unkind climatic patterns in recent years. It's not that the human race is experiencing climatic wrath first time in the history but the alarming side is its frequency, intensity and growing degree of unpredictability. According to scientific assessments of the Intergovernmental Panel on Climate Change (IPCC), the global world temperature has increased by 0.6oC over the last 100 years and is forecasted to rise further by 1.4 to 5.8oC before the present century ends.

Developing nations, specially in this region are more vulnerable to impact of climate related disasters. It's mainly due to weak governance, lack of desired infrastructure and technology, prevailing scale of poverty and more importantly the lack of leadership having vision and commitment to face and address this mounting threat.

Coastal areas are particularly the most vulnerable areas. With increasing temperature glaciers and icecaps are melting fast and raising sea levels. As the sea level rises, salt intrusion, tidal vector, inundation of low lying areas and cyclones also increase. It also makes the sea more aggressive and disastrous. A Greenpeace report warns that left unchecked climate change could lead to global temperature increases of between 4-5°C, unleashing a barrage of impacts that will drive mass migration in India, Pakistan and Bangladesh. A recent assessment indicates that tropical storms will indeed increase in frequency and/or intensity due to climate change (Trenberth 2005).

Tsunami Experience: Recent experience of Tsunami which hit Asian coasts on 26th Dec 2004 has made eye opening revelations. The impact was so immense and immediate that left no time to avoid the disaster. Early warning systems are being developed but still time margins between the warning and the disaster are too small to evade it. Tsunami proved that the only reliable shield against coastal disasters is nature. Wherever human being damaged this shield, Tsunami took its toll. Post disaster research carried out along the Tsunami-hit coast has surfaced several evidences that conservation of natural resources particularly mangroves and coral reefs is the best protection against climate change related disasters in coastal areas. Mangroves forests are the most effective wave energy absorbents. Research has shown mangroves are able to absorb between 70-90% of the energy from a normal wave. Amongst them the most important genera are Rhizophora, Bruguiera, Avicennia, Ceriops, Sonneratia, Lumnitzera, Aegiceras and Nypa. Mangroves provide double protection - the first layer of mangroves with their flexible branches and interweaved roots hanging in the coastal waters absorb the first shock waves. The second layer of tall mangroves than operates like a wall withstanding much of the wave energy.

It also happened earlier in Bangladesh. In 1960, a tsunami wave hit the coast in an area where mangroves were intact. There was not a single human loss. These mangroves were subsequently cut down and replaced with shrimp farms. In 1991, thousands of people were killed when a tsunami of the same magnitude hit the same region.

Ratan Kar and R. K. Kar of Birbal Sahni Institute of Palaeobotany, in their paper “Mangroves can check the wrath of tsunami” shared some insightful observations. According to the paper, “the data from Tamil Nadu. Kanyakumari, Nagapattinam, Pondicherry and Chennai have the dubious distinction for having maximum number of deaths and destruction of properties. All these places have high

density of population which led to the virtual disappearance of mangroves from the coast over several decades. But Pichavaram and the adjacent region near Chidambaram in the Cauvery delta have minimum causalities because of the thick mangrove vegetations which made the tsunami less lethal. This place is situated between Nagapattinam and Pondicherry and the tsunami might have struck it with the same lethal speed, yet it escaped mass destruction."

In a similar example, Myanmar and Maldives suffered very less from the killing spree of the tsunami because the tourism industry had so far not spread its tentacles to the virgin mangroves and coral reefs surrounding the coastline. The large coral reef surrounding the islands of Maldives absorbed much of the tidal energy and restricted the human loss to around 100 dead.

In another research, The World Conservation Union (IUCN) compared the death toll from two villages in Sri Lanka that were hit by the devastating giant waves. Two people died in the settlement with dense mangrove and scrub forest, while up to 6,000 people died in the village without similar vegetation.

The research has also proved that short term economic benefits at the cost of natural resources are outweighed by climate change disasters.

Since the 1960s, the Asian sea-coast region has been plundered by the large industrialised shrimp firms that brought environmentally-unfriendly aquaculture to its sea shores. Shrimp cultivation, rising to over 8 billion tonnes a year in the year 2000, had already played havoc with the fragile eco-systems. The "rape-and-run" industry, as the Food and Agricultural Organisation of the United Nations (FAO) once termed it, was largely funded by the World Bank.

Nearly 72 per cent of the shrimp farming is confined to Asia. The shrimp farming is carried out by removing mangrove in swamps. Since the 1960's, for instance, aquaculture in Thailand resulted in a loss of over 65,000 hectares of mangroves. In Indonesia, Java lost 70 per cent of its mangroves, Sulawesi 49 per cent and Sumatra 36 per cent. In India, mangrove cover has been reduced to less than a third of its original in the past three decades. Between 1963 and 1977, the period when aquaculture industry took roots, India destroyed nearly 50 per cent of its mangroves. Whatever remained of the mangroves was cut down by the hotel industry. In the past two decades, the entire coastline along the Bay of Bengal, Arabian Sea, and Strait of Malacca in the Indian Ocean and all along the South Pacific Ocean has been a witness to massive investments in tourism and hotels. All this greed took the toll of nature and in 2004 nature hit back leveling off all the profits accrued through myopic approach of development.

Having grown tenfold in the last 15 years, shrimp farming is now a $9 billion industry. Shrimp consumption in North America, Japan and Western Europe has increased by 300 per cent within the last ten years. The massive wave of destruction caused by the Dec 26 tsunami in 11 Asian countries alone has surpassed the economic gain that the shrimp industry claims to have harvested. With at least 150,000 people dead it also brought unprecedented socio-economic losses. World governments had to pledge US $ 4 billion in aid. This does not including the billions that are being spent by relief agencies. If all costs added, economic benefits of unwise development look too tiny.

Vulnerability of Sindh Coast: Sindh has over 350 kms long coast, rich in natural resources. The coastal areas of Sindh are most vulnerable and exposed to cyclones. According to some reports Sindh coast had an average of four cyclones in a century. However the frequency and intensity has increased manifold and the period

1971-2001 records 14 cyclones (A Review of Disaster Management Policies and Systems in Pakistan for WCDR 2005). The cyclone of 1999 in Thatta and Badin districts wiped out 73 settlements, and resulted in 168 lives lost, nearly 0.6 million people affected and killing of 11,000 cattle. It destroyed 1,800 small and big boats and partially damaged 642 boats, causing a loss of Rs 380 million. The losses to infrastructure were estimated at Rs750 million. Unofficial sources put these figures on much higher scale. Last year another cyclone Yemen narrowly missed Karachi coast and brought horrible disaster along Makran coast.

Sindh coast has been rich in mangroves forests but the recent decades have witnessed massive decline in mangroves forest due to shortage of environmental flows to Indus Delta. Till 19th century the delta would receive annually some 150 MAF water from the river system. This amount was gradually chopped off due to upstream developments in the shape of a series of dams and barrages. After the country came into being, a number of huge water sector development projects including two big dams Tarbella and Mangla along with Jinnah, Kotri, Marala, Taunsa and Guddu barrages have been implemented without taking into consideration their downstream climate change impacts. The water accord of 1991 provisionally guarantees 10 MAF subject to further studies to establish the actual need to maintain the delta eco-system. However ever since the accord came into place, the quantity of promised flow has hardly been maintained. This clause of the accord was neglected to the extent when in 2000-2001 the delta received less than one Million Acre Feet water. This reduced fresh water flow has also reduced inflow of nutrient loaded silt, which supports mangroves growth. Till late 70s the mangroves cover was approximately 260,000 hectares, which reduced to 160,000 hectares in early 90s. The recently conducted studies by WWF put the figures to a shocking low of about 80,000. In addition to that

sea intrusion has spoiled around 2 million acres of fertile land in Thatta and Badin.

In the recent years Sindh government and City Government of Karachi has kicked off a massive waterfront development program on Karachi coast. The illusive development also includes construction of a new city at Bundaar and Dingi islands, where few of the remaining healthy tracts of healthy mangroves are struggling for their survival. Another Dubai style city named as Sugarland city is being planned at Hawksbay. These developments are bound to make Karachi coast more vulnerable to climate change impacts. While Tsunami has forced governments to consider investing into natural resources, our decision makers are investing into disasters without realizing that cyclones, hurricanes and Tsunamis are not too alien to our coast.

Daily Dawn-14th April 2008

# Factors Responsible for Flood Disaster in Sindh

Heavy rains occurred in Balochistan in the end of June not only brought disaster in Balochistan but the districts of Sindh on its Eastern border also received devastating flash floods. Hill torrents originating from Balochistan entered Sindh through Khirthar hills and inundated vast areas in the districts of Dadu and Shahdad Kot/Qambar. Thousands lost their abodes and were marooned in deep pond of water for several days. Stories of their miseries and negligence of government machinery are widely reported in media. The unprecedented gushing flood from Mula and Bolan rivers badly shattered the flood protection network and the MNV/RBOD network breached at several places bringing havoc to local communities. The floods once again exposed the vulnerability of the drainage project executed by WAPDA on the Right Bank of Indus. A careful review of the flood disaster reveals that the disaster was not merely a natural calamity but the part of credit also goes to bad engineering, poor flood-management strategies and virtually collapsed institutional systems. There is no doubt that Irrigation Department made best possible efforts to manage the flood but the approach was reactionary. Knowing the climatic and topographic features of the area and the history of high floods, infrastructure building in the area required a more cautious approach but the policy wizards (both engineering and political) hardly give a thought to disaster before it really occurs and take its toll.

Torrential Floods in Sindh: Sindh province has two sources of flood. The Riverine flood is more predictable and allows ample time to

react whereas the torrential flood floods leave almost no time to respond. Torrential floods have lesser frequency and duration but very high intensity therefore impact is also sever. These floods normally occur in monsoon months of July and August when its catchment areas in Balochistan receive heavy rains. Western boundary of Sindh is connected with Blochistan through Khirthar hills. A series of ferocious torrents including Mula, Boolan, Khanji, Mazarani, Dillan, Buri, Salari, Shole, Gaaj, Angai, Naing and Bandani bring gushing waters from high altitudes of Khirthar to Kachhi plains of Sindh. This flood requires entirely different management systems, institutional capacities and infrastructure. High floods of 1942, 1944, 1948, 1956, 1973, 1975, 1976 and 1995 have sent several reminders of this fact. Among them floods of 1976 and 1995 were huge in magnitude and caused greater devastation to the flood protection infrastructure and local communities.

Flood Protection System in Kachhi Plains: Before the construction of Sukkur barrage, its command area on the right bank had natural drainage channels to carry torrential floods into Indus River. Part of flow would drain through Main Nara Valley Drain (an old river bed) and would feed into the fascinating echo system of once Asia's largest natural fresh water pond, Manachar Lake. In 1932, when the barrage was constructed, 70 miles long MNVD was properly shaped to carry a discharge of 2235 cusecs. Banks of MNVD also acted as flood protection barrier separating irrigated right bank areas of Sukkur command from hill torrents flood plain. The MNVD was later converted into RBOD by WAPDA to drain effluent from four districts, which devastated Manchar Lake. At one stage WAPDA was also bent upon connecting RBOD with Indus River but after lot of hue and cry by the civil society groups it retreated. Otherwise WAPDA would have added one more feather in their cap of catastrophic engineering products.

Flood Protection work in the torrential flood areas is much more vulnerable than the riverine flood protection work. In 1935 Flood Protection Bund (FP Bund) was constructed along the natural contours to facilitate North-South diversion of torrential flows towards Manchar Lake. The objective of this 172 miles long bund was to protect irrigated areas from flash floods and safe diversion of flood to natural pond at Manchar. According to the Indus River Commission, flood protection bund has to be provided with 6 feet Free Board above the recorded highest flood. In 1995, flood water overtopped the FP Bund at several locations and it was breached at more than 30 locations. However the restoration work just rehabilitated it to the pre-flood level and did not maintain new free board of 6 feet above the 1995 flood level. Also its remodeling was completed to only 120 RDs and the remaining part of 100 RDs was not remodeled, which faced the recent flood impact. This fact was also indicated in the Flood Fighting Plan for 2007 prepared by the local office of the Sindh Irrigation Department.

A Flood Diversion Bund has been provided to divert gushing flows of Gaaj Nai in Dadu district. The 6.4 miles long bund also protects FP Bund from the direct stroke of Gaj Nai. In super flood of 1995 this structure was badly damaged. This bund was also later remodeled to pre-flood condition. However no additional strengthening was provided if similar flood strikes again. Luckily this year Gaaj did not bring its usual flow and the bund survived any major damage.

This year the flood came from the north-western boundary with Balochistan and it hit the districts of Shahdad Kot/Qambar and later on Dadu district. Mula and Boolan rivers brought the major flows, which breached FP Bind at RD 179, 180, 184 and 230. It set off a series of breaches and cuts and 34 breaches and cutes were recorded in MNV Drain. These breaches inundated several small and large villages and it also threatened Qambar and Shahdad Kot

towns. A detailed Technical Assessment is required to establish the role of infrastructure and management system responsible for this havoc. A rapid assessment based on site visits, meetings with local communities, irrigation experts and civil society groups brought the following facts to light.

Effective early warning system is the key to manage flood disasters. Since torrential floods allow very limited time to respond, effectiveness of this system becomes even more important. It is strange to note that that there exists no flood warning system between Balochistan and Sindh provinces. Since Khairthar mountains receive flood from Balochistan, there should be a mechanism by which Balochistan Government can inform Sindh Government well in time to take necessary precautions. Sindh Irrigation Department has only one gauge station at the mouth of Gaaj Nai in Dadu district. Flash flood from this point hardly takes 12 hours to reach mainstream areas. Even if the earliest warning is received, this duration is insufficient to manage any catastrophe in making. The modern weather forecast systems based on satellite information sources has made it possible to develop a fairly reliable flood warning system. It will definitely cost much less than what the government normally spends on repair of damaged infrastructure and relief and rehabilitation of devastated communities. Environmental, economic and social cost of losses will further justify this much deserving investment. This can be gauged from the fact that after 1995 flood damages, strengthening of Gaj Diversion Bund at Gaj Nai and FP Bund cost about 700 million rupees to public exchequer. Effective flood warning system will also help timely evacuation of vulnerable areas identified through careful mapping of flood prone communities.

Infrastructure development in the flood plains is not being designed with prior understanding of natural flood routes. Irrigation experts believe that the road network in the area has also obstructed the

free flow of flood. Some local roads and Rato Dero-Khuzdar Motorway are aligned against the flood flows and have inadequate cross drainage provision, causing bouncing of flood water. There is no mechanism whereby National Highway Authority or Provincial Highway Department seeks Irrigation Department's advice on the road alignment in the Kachhi flood plain. This lack of institutional networking is likely to cause more damage in future.

Time and again it has been proved that tempering nature beyond a limit invites terrible consequences. WAPDA's experiment of converting fresh water MNVD into a saline water channel of RBOD resulted in disaster to Manchar Lake. Now WAPDA is undertaking several drainage schemes in upper reaches through RBOD-III which will canalize effluent from Balochistan's irrigated areas and drain it to the main RBOD drain. A complex drainage network for Usta Mohammad areas is under construction and existing EBOD is being connected to Hairdin drain and Chukhi through new drains under RBOD-III which will be ultimately connected with main RBOD network. There are strong political elements behind these decisions and WAPDA does not bother to involve Irrigation Department at local level to assess the potential threats which may stem through this made drive of drainage projects. According to officials of the Irrigation Department such coordination is virtually non-existent and if any consultation takes place it is restricted to higher offices which have little understanding of ground realities. Since WAPDA executes federal government's politically motivated projects, it hardly gives any ear to the local irrigation departments, civil society groups and communities. Failure of LBOD should have been enough lesson to learn from but it does not seem happening. Local Irrigation experts also believe that the designed capacity of RBOD-III is also insufficient to carry normal flows of the local drains let alone heavy storm water. In recent flood Miro Khan and Shahda Kot drains experienced backflow since MNV was facing high flood. This could have inundated Shahdad Kot and Miro Khan towns. Therefore

this drainage network is posing a permanent threat to local areas. Likewise if Indus River receives heavy flood (above 700,000 cusecs), chances are high that it may choke RBOD-II at Bago Toro hills near Sehwan, which flows very close to Indus River.

Drainage system in the area is being developed as stand-alone engineering infrastructure rather than as part of a management package. There is a need to address the misuse of water in head reaches of Rice cultivation areas to reduce the quantity of drainage effluent. Irrigation system designed in British Period did not require drainage because it was based on judicious supply in head and tail reaches; violation of which has created the problem. Addressing root cause is more prudent rather than addressing effects, which WAPDA is practicing since years. This wrong approach has made drainage sector schemes in the country a long term liability and source of multiple disasters. This ill motivated approach is being enjoyed by a chain of powerful beneficiaries therefore it does not seem changing in foreseeable future.

Flood Control Plan for Sindh Province was developed in 1978 and has not been revised since then. Whole landscape has undergone several changes over the years and living with three decades old flood management system indicates the prevalence of institutional bankruptcy. This needs to be revised based on the experiences of last thirty years and new ground realities. Likewise Bund manual was also developed in 1978 and merits revision.

These and many other such facts reveal that the recent flood disaster was not merely an act of unkind nature but it was actually a resultant of bad planning, poor coordination and a complete institutional mess.

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# Disaster unleashed by Mirani Dam

Cyclone Yemyin hit Balochistan coast on the night between June 26-27, 2007 and left deep scars of disaster on villages of Kech District. The unusual rainfall resulted in deluge in Nihing and Kech rivers, which caused backflow in several kilometers. The worst hit areas included union councils of Nasirabad, Nodiz and Kosh Kalat. According to a Red Cross report, the loss of houses in the two union councils was 100 per cent whereas the third one lost about 75 per cent of the houses.

The figures of completely demolished houses include 2,742 in Nasirabad, 2,949 in Nodiz and 996 in Kosh Kalat. Several thousand people were rendered homeless and are currently passing difficult days in makeshift camps. These affectees do not solely blame nature for their plight; they count Mirani Dam as a major man-made factor responsible for this unprecedented devastation.

These union councils give a completely deserted look and only few traces of buried villages are visible, where villagers are seen excavating piles of debris to find whatever remains they could recover. They were lucky enough to save their souls. Some of them remained marooned for several hours before their rescue.

Kech River has its catchment area in Balochistan, whereas the Nihing River brings torrential water from Iran. At the point of their confluence they merge into Dasht River which flows into Arabian Sea near Jiwani. Dasht River is a non-perennial river depending on rain flows of catchment area spread over 21,000 sq kms. These rivers turned violent after colliding with Mirani Dam reservoir on the fateful night of June 27. Local communities blame WAPDA and its consultants for the recent disaster and they consider Mirani Dam as the single largest cause of this scale of disaster.

Mirani Dam is constructed on Dasht River at seven kms downstream of the point of confluence of Nihing and Kech Rivers. Construction work of the dam commenced on July 8, 2002 under WAPDA's Vision-2025 as part of its Water Resource Development Programme. The project remained a high profile activity due to the highest level of political involvement from the day one. It drew strong opposition by nationalist parties of Balochistan and the local communities.

According to the PC-1, the estimated cost of the project was Rs5.81 billion. Total storage capacity of the dam is 302,000 acre feet, which includes a dead level of 150,000 acre feet, leaving usable water of 152,000 acre feet. Total height of the dam is 127 ft from ground. Top width of the dam wall is 35 feet and it has a 600 feet wide spillway, which can allow a flow of 384,000 cusecs. The major objective of the dam to irrigate 33,000 acres of land in Dasht area. President Musharaf inaugurated this much trumpeted harbinger of prosperity on November 16, 2006--- about eight months before it was confirmed that the fears of local communities were not unfounded.

Kech district received unprecedented rain as cyclone Yemyin landed on the Balochistan coast on June 26. Both Nihing and Kech rivers received heavy inflows from numerous tributaries. Flash flood poured water into Dasht River, which could not drain freely due to the Mirani Dam structure. Capacity full reservoir refused to absorb more inflow and the two rivers pounded back in all directions. Backflows brought unpredicted flash floods in the villages all around and inundated dozens of villages as far as 35 kilo meters from the confluence point. Several small torrents contributing to Kech River also started flowing back hence the whole area came under flood sheet from all directions.

According to NESPAK (consultant firm of WAPDA, responsible for dam construction and operation currently) flood water touched the

level of 271.44 feet above mean sea level, leaving only three feet to overtop the dam wall. At one stage WAPDA engineers contemplated using fuse plug to break spillway to allow more flow but the option was avoided since it involved risk of bursting the dam body, which would have multiplied the disaster manifold.

WADPA asserts that had there not been Mirani Dam, flood would have brought far more disaster in downstream areas. However, local communities do not subscribe to this claim. In absence of dam body, flood would have flown uninterrupted through the downstream areas, from where low lying villages had already shifted to perched areas after the heavy flood of 1998. Dam body filled with water caused a major impediment in the free flow of Dasht River. As a result of which reverse flow in torrential rivers brought disaster in vast areas.

The disaster also proved that over ruling local wisdom and relying solely on text book engineering would always result in losses. This has also been proved by the failure of Left Bank Outfall Drain in Sindh. At the time of construction of Mirani Dam, WPDA claimed that flood surpassing 244 feet above mean sea level (ASML) at dam site has a rare possibility of once in 200 years. However, local communities and some irrigation department officials stressed that WAPDA should raise its elevation to 264 ft ASML and resettle people coming under this flood level. However WAPDA remained adamant and did not compensate and relocate villages above 244 ft ASML. The recent flood caused severe damages in the areas even above 264 ft ASML.

According to some reports when feasibility of the dam was prepared in 1956, its height was proposed as 80 ft as against 127 ft now. Local communities are of the opinion that 80 ft was a safe height for the dam. They also claim that WAPDA was requested to provide at least 1,200 ft wide spillway to manage unpredictably high flash floods but they rejected this proposal. Interestingly, now

consultants of WAPDA have proposed construction of another 600 ft long spillway on the right side of the dam body, which is proposed to operate at 255 ft ASML. This proves that the concerns of the local communities were valid and it was a big mistake on part of decision makers not to address them.

Local communities and irrigation department officials are also unaware of any Environmental Impact Assessment (EIA) of the project. No one ever witnessed any public hearing which is mandatory for any EIA required under Pakistan Environmental Protection Act-1997. Interestingly WAPDA's construction consultants are also unaware of any EIA stipulations of the project. Had there been any EIA, local communities would have formally registered their concerns and suggestions. It seems that this vital part of the project has either been ignored or conducted without stakeholder consultation, rendering it completely ineffective.

Likewise PC-1 of the project has also been made a confidential document and even responsible officials of local irrigation department-which has to take over the project on completion-assert that they have no access to PC-1 of the project. Dam site is a high security area where even future operators of the dam, irrigation department people have no access. This indicates that that stakeholder participation has been completely avoided in the project design, planning and execution. This has become typical of public sector projects, which causes often serious design mistakes in the project resulting in waste of resources and loss of lives of local communities. Unfortunately our planning wizards have never considered common folk's wisdom and termed their concerns as anti-development conspiracies.

How the recent flood has affected the dam, is not yet public knowledge. WAPDA consultants are content that the dam structure has survived the huge flood and therefore it is a successful engineering structure. Yet they are silent on the level of silt that the

flood would have brought along. In the track of backflow of Keck River and its tributaries, one to two feet thick clay cakes are visible. This deposition indicates heavy silting in the dam that might have reduced the dam's life by few years.

According to WAPDA consultants the dam is designed to last for 50 years. Local communities claim that since the dam is actually constructed to provide water to the industrial and residential areas of the emerging port city of Gwadar, the government might consider raising the dam height in future to compensate the reservoir loss due to silting. They apprehend that any such experiment would inundate more villages at the fringes of the water body and future floods may bring even bigger disaster if the dam level is raised at any later stage.

The dams are highly risky engineering structures. Dam designs and operational safety features are highly dependent on accuracy of the history of floods in its catchment. But the fast changing climatic patterns have made the nature even more unpredictable and made dam structures more vulnerable. In recent years climate change has started manifesting its impacts in various ways. Tsunami, cyclones, hurricanes and floods are becoming more rampant and it would be better to explore other safer options to achieve the objectives connected with dams. Mirani Dam episode also raises a concern that if a small dam (Kalabagh dam would have 20 times more storage than Mirani Dam) can unleash such a disaster, what would be the scale of disaster if any mishap occurs through big dams. Water conservation, power generation and land development are appreciable objectives but they are all meant for citizens' development. But no risky means should be adopted to achieve these objectives if human beings have to face bigger risks and pay higher prices.


**Strengthening Participatory Organization (SPO)** is one of the largest rights-based civil society organizations in Pakistan. It strives to address the emerging issues in the particular socio-economic and political context of Pakistan through its core programme areas of democratic governance, social justice and peace and social harmony. In addition, SPO has a component of humanitarian response that deals with disasters and emergency situations, such as earthquake in Azad Kashmir, floods in Balochistan, Internally Displaced Persons (IDPs) of Khyber Pakhtoonkhwa and relief activities in the flood affected areas of AJK, Khyber Pakhtunkhwa, Balochistan, Punjab and Sindh.

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**SPO NATIONAL CENTER**
House 429, Street. 11, F-10/2, Islamabad, Pakistan
Tel: +92-51-2104677, 2104679, 2104680 UAN: 111 357 111 Fax: +92-51-2112787
Info@spopk.org www.spopk.org

**BALOCHISTAN**

**SPO QUETTA**
House 55-B, Near Working Women Hostel, Jinnah Town, Quetta
Tel: 081-2870750, 2870752
Fax: 081-2870751
Email: quetta@spopk.org

**SPO TURBAT**
Pasni Road,
Turbat
Tel: 0852-412333
Fax: 0852-413884
Email: turbat@spopk.org

**KHYBER PAKHTUNKHWA**

**SPO PESHAWAR**
House 15, Street 1, Sector N-4
Phase 4, Hayatabad, Peshawar
Tel: 091-5810021, 5811792
Fax: 091-5813089
Email: peshawar@spopk.org

**SPO D.I.KHAN**
House 2, Street 2,
Wensam Housing Scheme,
Near Wensam College,
D.I.Khan
Tel: 0966-713231
Fax: 0966-733917
Email: dikhan@spopk.org

**PUNJAB**

**SPO MULTAN**
House 339-340, Block-D
Shah Rukh-e-Alam Colony
Multan
Tel: 061-6772995, 4551681
Fax: 061-6772996
Email: multan@spopk.org

**SPO LAHORE**
House 76-A, Sher Shah Block
New Garden Town,
lahore
Tel: 042-35863211, 35863212
Fax: 042-35863213
Email: lahore@spopk.org

**SINDH**

**SPO HYDERABAD**
Plot 158/2, Behind M. Usman
Deplai Scheme Academy
Alamdar Chowk, Grid Station
Qasimabad, Hyderabad
Tel: 0222-654725
Fax: 0222-6521126
Email: hyderabad@spopk.org

**SPO KARACHI**
G-22, B/2, Park Lane
Clifton Block 5, Karachi
Tel: 021-5836213, 5873405
Fax: 021-5873794
Email: karachi@spopk.org

**AJK**

**SPO MUZAFFARABAD**
House B-35,
Upper Chathar
Muzaffarabad
Tel: 05822-434432
Fax: 05822-434415
Email: muzaffarabad@spopk.org