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Research Article

Averting a Water War through Surface Water Management in Pakistan

"Announce to them how water must be shared among them; each will have his own special time to drink" Al-Quraan (Sura 54 The Moon, ayat 28).

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Abstract: Water is life line. Pakistan is close to becoming a water scarce country owing to our own poor water management coupled with exploitation of water resources by our neighbouring country India. If unfortunately, we become dependent on our neighbours for meeting our water requirements, they need not to wage war to enforce their dictations on us. A quantitative analysis has been carried out from extensive literature review and research studies. The paper highlights the growing water scarcity issues of Pakistan and control of water resources by India, contrary to the Indus Water Treaty. It also suggests the water management and conservation practices and sheds light on exploring new possibilities to meet our growing water demands. This study emphasizes in detail about the repercussions if we fail to realize the importance of this precious commodity and underlines importance of the needed institutional reforms. It also suggests the way forward in order to be able to meet the future challenges to avert the imminent water crisis in our country.

Keywords: Water resources, management, scarcity, issues, surface water, water economics, water reservoir, repercussions, institutional reforms

1. INTRODUCTION

The importance of water needs no explanation. It's the life line for living beings and is one of the most essential sources of existence of life. But as the world population is increasing rapidly, the water requirements are also on rise which is aggravated manifolds due to dwindling natural resources and unnecessary wastage of this invaluable source, so much so that it is now likely to threaten the peaceful co-existence of otherwise nonviolent neighbours. The water demands of the world have risen to 6 times that of its population in the last century and this thirst for water could possibly become the most significant politico-economic issue of the current century.

The conflicts for gaining control over the water resources will not be restricted to a particular part of the world, but it is likely to engulf every corner of the world ranging from the developed countries to the poorer nations. With the clock ticking, the water requirement for every nation/country on the globe is going to intensify forcing them to make necessary arrangements to meet their growing day to day water demands. The depletion of this natural resource is liable to effect the world considerably in near future and Pakistan is no exception. One of the greatest divisions in the history of mankind in the form of partition of Indian subcontinent in 1947 was also based on this fact and the interstate boundary between India and Pakistan was decided across the Indus Basin. Pakistan unfortunately became the lower riparian because of her geographical location. Despite other disputes of unfair allocation of assets and resources between the two new born states, the unjustified distribution of water resources laid the foundation of contentions between these two neighbours since their inception. These issues of distribution and utilization of water, management of these resources and construction of mega hydel power projects across the interstate boundaries are

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directly affecting these upper and lower riparian countries. It is gaining prime importance because of the scarcity and limited water availability, droughts and floods in these regions.

Pakistan's water related problems are aggravating owing to poor management of the available water resources, absolute ignorance about the importance of constructing new water reservoirs, considerable reduction of the storage capacity of the existing dams, climatic changes leading to drought conditions almost every year and the foremost being the criminal breach of the most enduring pact between two countries called the Indus Water Treaty by India. By their ambitious mega hydro-power projects like the Wular Barrage, Baglihar Dam and most recently Kishenganga Dam, India is aiming at suffocating Pakistan's economy which is heavily dependant upon agriculture, putting country's very survival at stake. Owing to her hegemonious designs, India has also been reported to aid Afghanistan for construction of two dams on Kabul River which is a tributary of river Indus. Besides dehydrating Pakistan, if India gains the control of water in this region, the strategic importance of these projects can have far reaching effects on the defense security concerns of our country.

It is high time that we start working on war footing to address this very serious issue as we are racing towards becoming a water stressed country in near future. Besides improving the water distribution and management issues, construction of new water reservoirs is the need of the hour. We also need to advocate the misplaced use of water resources by India on one pretext or the other. If we don't handle this issue technically without any legal framework, it is likely to be aggravated so much so that it could threaten a Nuclear war between the two countries. By gaining the control over this precious resource, India could easily dictate her terms in this region without waging a war. Therefore, an effort has been made through this article by highlighting the water resources available to Pakistan vis-à-vis Indian plans to construct 52 water projects [1] thereby draining most of the rivers in Pakistan paving the way for making it a water starved country like Ethiopia .

2. PAKISTAN'S SURFACE WATER RESOURCES

The surface water resources of Pakistan can be divided into three hydrological basins namely, the Indus Basin, Kharan Closed basin and the Makran coastal basin. The Indus basin covers almost 65% of the area of Pakistan and is obviously the largest basin in the country. This basin is located in two other countries besides Pakistan. About 10% of it is located in China and Indian Occupied Kashmir, each, 8% in Afghanistan and 7% in Azad Jammu and Kashmir [2]. It is spread all the way from mountainous areas of North and West to the Indus and Kacchi plains and the desert areas of Baluchistan and Sindh. The catchment area of Indus River system is 364, 700 sq miles. The major rivers in this system include Indus, Jhelum, Kabul, Chenab, Ravi, Sutlej and Beas out of which exclusive rights of the first four listed rivers rest with Pakistan. This basin contributes 141.67 MAF of water annually.

Kharan closed basin covers about 15% of the area in Pakistan stretching from northwest of Baluchistan comprising Kharan Desert and Pishin basins. 73% of this basin consists of mountainous areas. The large plateau comprises of 46,400 sq miles of arid region and the water resource potential of this area is estimated to be 0.79 MAF. The important rivers which are the prime source of water in this basin are Mashkel and Marjen, with Marjen being the minor tributary of Mashkel.

Makran coastal basin is located along the coastal belt of Baluchistan and covers 17% of the area of Pakistan. It is spread over an area of 47,300 sq miles and like Kharan basin, consists of 70% mountainous area. The principal rivers contributing water to this basin are Hub, Porali, Hingol and Dasht, which is 3 MAF annually. So, in total, around 146 MAF of surface water is annually available to Pakistan in addition to the rainfall and groundwater sources.

3. SURFACE WATER STORAGE RESERVOIRS

There are about 143 dams in Pakistan including 3 super storage reservoirs namely, Tarbela, Mangla and Chashma. Besides this, some new dams like Diamer-Bhasha dam is also in planning stages with

a live storage capacity around 6 MAF. The designed live storage capacity of Indus basin is 18.92 MAF, which includes 9.7 MAF of Tarbela, 8.51 MAF of Mangla (including new raising) and 0.71 MAF of Chashma. But due to silting, this live storage capacity has been reduced to 14.5 MAF showing a loss of almost 22% of the existing storage capacity [3]. Loss of each MAF of the storage capacity means 1MAF/year reduced water availability with a given level of reliability each year. Because of heavy siltation load from the Himalayas, our 2 main storage reservoirs are being deprived of their existing storage capacities every year. Owing to the already depleting water availability throughout the country, need for building additional storage reservoirs is becoming very important.

The extreme high and low flow characteristics of the rivers are managed by these reservoirs in order to efficiently utilize the summer surplus flows besides meeting the inter basin requirements. The total irrigation water supply requirements of Pakistan are mainly dependant upon these water storage reservoirs in addition to electric power generation. Most of the rivers flows are perennial which is primarily derived from rainfall, snow and glacial melt. Since the river flow is not consistent, water storage reservoirs are required so that surplus water can be stored for drought periods or when rainfall is very less. Unfortunately, as compared with other arid countries, the water storage capacity of Pakistan is very low. Pakistan can hardly store 30 days of water in the Indus basin which comes to about 150 m^3/capita as compared to 5000 m^3/capita for USA and Australia which is as shown in Fig. 1 [4].

4. ANNUAL WATER AVAILABILITY VIS-À-VIS DEMANDS

Absence of new storage reservoirs, climate change effects, poor water conservation practices and increasing population are leading to rapid depletion of water resources in Pakistan. We are heading towards becoming a water short country because the water availability per capita has drastically declined from 5300 m^3 to around 1000 m^3/capita per year since independence. Diversion of our river waters in sheer violation of the Indus water treaty by India is adding to this critical situation. In order to save Pakistan's economy from total collapse, which is totally dependant on agriculture, we must address this issue immediately and try to at least replenish the lost capacity with a comprehensive plan to increase our water storage capability. The data on water availability in Pakistan for 75 years is presented in Table 1 [5].

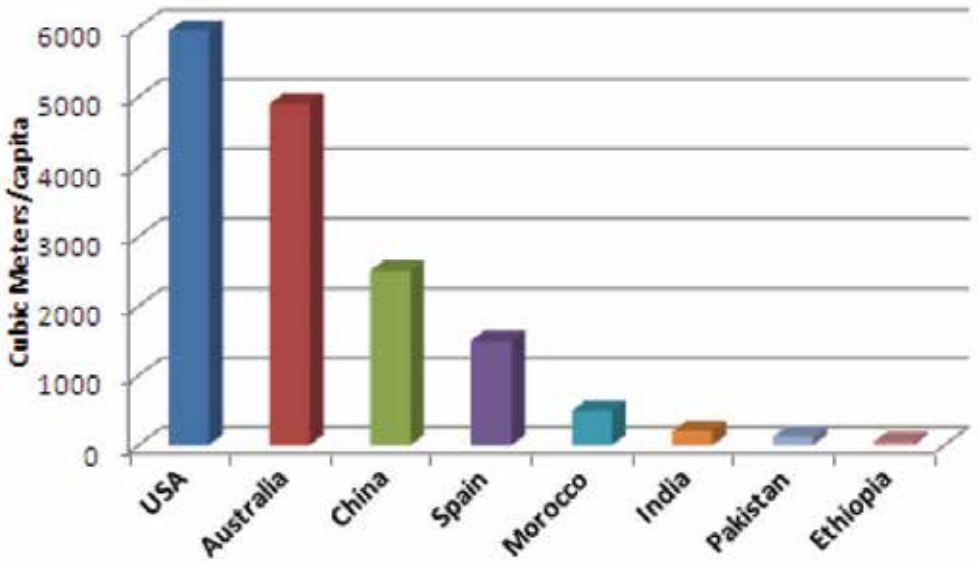

Fig. 1. Some salient countries' water availability data.

Table 1. 75-year water availability data of Pakistan.

Year	Population (million)	Water Availability (m^3)
1951	34	5300
1961	46	3950
1971	65	2700
1981	84	2100
1991	115	1600
2001	148	1200
2011	170	1050
2025	267	660

Source: UNDP Report (2005)

Water resources are the backbone of Pakistan's economy, as we are one of the world's arid countries. Our irrigation system is one of the largest contiguous irrigation systems of the world on which our agriculture system is wholly dependant. It constitutes almost 90% of our food requirements and contributes 24% of its Gross Domestic Products (GDP). Two thirds of the population living in rural areas are dependent upon agriculture which absorbs 50% of the labour force and also provides 75% of the foreign exports in terms of raw materials and other value added products [6]. This issue becomes more complex since more than 75% of water available to Pakistan is outside her territory. The use of water for agriculture is around 97% as our irrigated area has seen an increase of almost 100% in the past 50 years. The critical shortage of water is likely to endanger the food security and livelihood of our people.

5. DRAINING OF PAKISTAN'S WATER SHARE

The famous Indus Water Treaty which was hampered between the two countries in 1960 clearly defines the shares of water resources for both the countries, assigning their rights and obligations in this regard. Three western rivers (Indus, Jhelum and Chenab) were given to Pakistan while the three rivers (Ravi, Beas and Sutlej) on eastern side to India. Both the countries were given unrestricted use of the above mentioned rivers. They were put under an obligation not to stop or interfere with the flow of water in their respective rivers except for domestic and non-consumptive use. However, India was allowed limited use of western rivers for irrigation purposes. India is not only making full use of its allocated share but has also started ambitious projects like Kishenganga, Baglihar and Wular barrage on the western rivers on one pretext or the other like provision of cheap electricity to the people of Jammu and Kashmir, limited use of water for hydroelectric projects as envisaged in the treaty. The construction of these dams has serious reverberations for Pakistan in future, some of which have already been witnessed by us in recent past. The location of these structures is shown in Fig. 2 [7].

Fig. 2. Rivers flowing into Pakistan and the location of Indian hydropower projects.

5.1 Wular Barrage

India started the construction of Wular Barrage in 1985 on river Jhelum at the mouth of Wular Lake, near Sopore town in Kashmir Valley. India calls it as Tulbul Navigation Project. The maximum designed storage capacity is 0.30 MAF. India's stance on this project is to make the Jhelum river navigable during summer [8].

5.2 Kishenganga Dam

The construction on this project started in 2006, owing to the advantage taken by the Indian authorities because of unnecessary delay in the completion of Neelum-Jhelum Project by Pakistan due to budgetary constraints. It is being constructed on Kishenganga River which is called the Neelum River in Pakistan. It is designed to divert the water of this river into Wular Lake. Its live storage capacity is 0.012 MAF with power generation of 330 MW, but it will adversely affect the Neelum Jhelum Project which is just 70 km downstream of Kishenganga and reduce its hydro-power generation capacity of 969 MW by 11% incurring a loss of around $141 billion annually [9].

5.3 Baglihar Dam Project

This project is located at Chanderkot in Ramban, Southern Doda District of Indian occupied Kashmir. Construction on this project started in 1999. It has been built on River Chenab which has its origin in Indian state of Himachal Paradesh. The storage capacity of this dam is 0.16 MAF [10]. This project will deprive Pakistan of 0.32 MAF during agricultural season. India is capable of blocking the entire water of Chenab for 20-25 days.

5.4 Dams on River Indus

5.4.1 *Nimoo Bazgo Project*

It is a run of the river project constructed on River Indus about 70 kms from Leh District in Indian held Kashmir. The construction started on this project in 2005 [11].

5.4.2 *Dumkhar Hydel Power Project*

This dam is also run of the river project on Indus River located in Leh District of Indian Held Jammu and Kashmir [12].

5.4.3 *Chutak Hydroelectirc Project*

It is another run of the river power project on Suru River which is tributary of River Indus. This project is located in Kargil District of Jammu and Kashmir [13].

5.4.4 *Kargil Dam Project*

India is also constructing third largest dam of the world in Kargil district of Indian held Kashmir on the Indus River which will give her the capacity to block 45% of the water flowing into Pakistan [14].

5.5 Dams on Kabul River

The Afghan government is planning to construct at least 12 multi purpose water projects on Kabul River and its tributaries with International community's assistance. Indian experts are extending technical help to Afghanistan for building such dams with a storage capacity as high as 4.7 MAF.

6. REPERCUSSIONS FOR PAKISTAN

These ambitious Indian Hydropower projects being undertaken by India and her assistance to Afghanistan for this purpose are likely to have serious implications for Pakistan which are highlighted as under:

6.1 Agricultural Implications

As discussed above, Pakistan's economy is extensively based on agriculture. Our agriculture is wholly dependant on the irrigation system of our country. 97% use of water is allocated for this purpose. By building large and small dams, India is likely to gain significant control on our water resources with the capability to stop the water during agricultural season and also by releasing excessive water when it is otherwise not required. This will have a drastic effect on our crop production and might lead to crop failures in most parts of the country. Water availability issues will show the way to lower crop yields, downfall in live stock, shutting down of agriculture based industries. These projects will have serious implications on the irrigated areas around the Rivers and ultimately force the farmers to change their cropping patterns leading to starvation and acute food shortage and

drought through out the country.

The use of water for hydropower production is not apparently going to affect the quantity of water reaching Pakistan but the important cause of concern will be the natural timings of those flows. Interference with the timings of flows will become crucial since the irrigating areas in Pakistan will be adversely affected if the flows are not provided at the crucial timing of planting seasons. This will have far reaching negative affects on Pakistan's agricultural productions.

6.2 Economic Repercussions

Since agriculture is the life line of our economy, artificial water shortages and flooding of our lands is going to affect our economy considerably. If the water is held up during scarcity and excessive water is released during monsoon leading to vast flooding, already burdened country's economy will be stressed further because of diversion of a huge chunk of funds for tackling such issues. These problems will further aggravate thereby increasing the unemployment rates and will eventually lead to more economic dependence on other countries making Pakistan bow to unnecessary International terms.

In January 2010, 40% decline in the average flows of Chenab Rivers was observed due to construction of Baglihar dam and is going to adversely affect the irrigation system which is dependent on Chenab River. This also resulted in reduced flow at Marala Headworks during filing of this dam in 2008 and caused colossal economic losses because of scarcity of irrigation water for the paddy crops in the Marala canal command areas spread over 10,000,000 acres [15]. The diversion of water from the Neelum (Kishenganga) River will change its course and will join Jhelum River through Wular Lake in Baramulla district in Indian held Kashmir, which otherwise join each other at Domail near Muzaffarabad. Despite loss of millions of dollars annually because of around 11% loss in power generation capacity of Neelum Jhelum project, it will also threaten to render the fertile Neelum valley barren. The Wular Barrage gives India total control of waters of River Jhelum and could easily deprive Pakistan's due share in winters resulting in loss of irrigated areas downstream. This barrage also has the potential to disrupt the triple canal project of Pakistan-Upper Jhelum Canal, Upper Chenab Canal and the Lower Bari Doab Canal [16].

In 2011, India released around 100,000 cusecs of additional water in River Sutlej which her dams and storage reservoirs could not accommodate without any warning to Pakistan [16]. This resulted in flooding of dozens of villages in Kasur district inflicting loss of billions of rupees to already struggling economy of our country.

6.3 Tactical Implications

The issue of management, distribution, utilization of water resources tarnish the already feeble bilateral relations between the subcontinental states. Mega hydropower generation projects which affect the upper and lower riparian states are likely to take centre stage in defining the interstate relationships because of the water scarcity leading to droughts and floods in these states. The Indian control on the major water resources leading to Pakistan and in addition to this, her assistance for building dams on Kabul River are a serious security threat. It's a step further for Indian designs to establish her hegemony over this region. Indian ability to manage the water of River Jhelum and Chenab pose a challenge to the first line of our defence system. If the canals and tributaries originating from these rivers are dried up by blockage of water by India, our tactical maneuvers need to be revisited. Similarly, if huge quantity of water is released by India or some of her hydraulic structure malfunctions or is deliberately collapsed, it can become a disaster for our cities and villages thereby endangering our very existence. India can use these water resources to her full advantage as we are already touching the borderline of becoming a water starved country. It is quite clear from the Fig. 2, that almost all the rivers flowing into Pakistan have been capped by India, and her intentions to fund Afghanistan for the same purpose can leave Pakistan with no other option than to be dictated by Indian terms. India can achieve strategic advantage without waging a full fledge war which otherwise India couldn't accomplish after fighting three wars in last decades. If still we are oblivious of this looming threat with

a great potential of a Nuclear war and do not handle it technically without devising a thorough legal mechanism, fate of Pakistan turning into a desert cannot be averted. This will eventually be clubbed with the Kashmir issue, which Quaid-e-Azam had rightly declared as the Jugular vein of our country.

6.4 Political Aftermath

Despite of other disastrous consequences of acute water shortage, the distribution of water between our provinces has always been a hard nut to crack in which Punjab being an upper riparian is always accused of usurping the right of access to water by Sindh and Baluchistan being lower riparian. The water shortage issues will overstretch the water resources thereby creating a sense of mistrust between the federating units putting Pakistan's existence at stake.

Criminal negligence on the part of our leaders by politicizing the Kalabagh dam project which had already completed the planning phase and unpardonable delay in construction of major reservoirs including the Bhasha Dam will have long term implications for Pakistan. It is highly unfortunate that the population in irrigated areas of Southern Punjab, Sindh and Baluchistan are ignorant of the possible horrifying scenario when they will have to face severe water shortages for cultivations of the crops and possibly drinking water availability. If our leadership still use this issue for their own sinister political motives, they might take Pakistan to the verge of devastation. We will not realize the original worth of this invaluable natural resource until the well is dried up while we are busy in fighting over petty issues of inter provincial distribution of water.

7. AVERTING WATER CRISIS-WAY FORWARD

7.1 Public Awareness

First and foremost, perhaps the most important steps is to create public awareness at national level to apprise the nation about the ominous and disastrous fate awaiting us if we don't wake up and start working on war footings to address the issue which is threatening our very existence.

7.1.1 Population Explosion

There are extensive debates that the country's water availability has been reduced from 5300 cm^3 in 1950's to a mere 1000 cm^3 annually in 2012 adding Pakistan in the list of water starved countries. But the major cause of this decline in water availability is drastic increase in population vis-à-vis available water resources. This issue needs attention as the higher rates of population will squeeze the existing resources of the country whether it be water availability or access to basic amenities and resources.

7.1.2 Water Distribution among Provinces

It is the prime duties of the authorities and leaders to put the nation wise on the seriousness of the water crisis and it's the dire need of the hour to rise above our own provincial interests for the sake of our country and evolve a detailed mechanism of water distribution among the provinces which if not addressed immediately may land Pakistan in deep trouble at the wake of severe water shortages in coming future. In addition, mindset is to be changed by highlighting the advantages of the new water reservoirs putting politics aside.

7.1.3 Water Conservation

We cannot afford to waste this precious resource anymore since we are at the brink of being a water short country. The masses need to be educated about simple conservation practices which will enable us to save considerable amounts of water. This practice is being carried out in developed countries like USA despite of the fact that their water availability per capita is over 5000 cm^3 per annum but they are otherwise well aware of the value of this natural resource.

7.1.4 Changing agricultural practices.

We need to focus on latest research being carried out in agriculture. Incorporation of changes in our cropping patterns needs attention and crops requiring lesser water may be replaced by high water consuming crops. The present irrigation techniques may be replaced with new and modern practices like drip irrigation which may be investigated for implementation for improved conservation of water.

7.2 Awareness of International Community

So far we have failed to plead our case in an effective manner to the International community about the severity of water crisis in this region at the hands of India.

7.2.1 Diplomacy

Aggressive diplomatic efforts are required to bring the looming threat of a potential Nuclear war between two arch rivals into the notice of world community if this unfair thievery is not stopped by India. The latest ambitious hydro power projects being constructed or planned by India and technical assistance to Afghanistan could be used by them in choking off the Pakistan's economy turning it into a desert. This could threaten the lively hoods of our population and if not tackled at this stage could jeopardize the peace and security of the region.

7.2.2 Indus Basin Treaty

This treaty which was signed in 1960 needs revision as it was based on the flows of 1960's where water availability and demand was not a critical issue as it has become nowadays. At least respecting this treaty in true letter and spirit may be pursued and India should be stopped by taking advantage of the technical loop holes in the treaty until more effective and vibrant negotiations leading to revisions in the treaty are worked out which duly regards the rights of lower riparian. The incorporation of Water Apportionment Accord of 1991 also need to be incorporated in the amended/ or newer version of the treaty.

7.2.3 Confidence building Measures

We need to take confidence building measures with India and Afghanistan and try to establish a joint multi disciplinary fact finding group consisting of scientific and technical experts to build a mutually agreed upon hydrological knowledge base on the emerging water scenario in the region. These states should keep on exploring mutually verifiable confidence building measures in order to eradicate or at least lessen the sources of mistrust on trans-boundary water management issues. There is a need to agree on setting up of a permanent independent and separate framework or neutral expert's assessment so that policy makers of these states could follow a workable remedial course of action.

7.3 Institutional Reforms

We need to strengthen our Institutions like IRSA, WAPDA, and Irrigation Department etc. for better management of our water resources especially to devise a workable and a permanent solution of distribution of water amongst provinces. The irrigation and water sectors need to be reformed and reorganized on modern lines incorporating latest trends and research in dealing and managing water problems. Our irrigation system which is one of the largest irrigation networks of the world require revisiting so that the efficiency is increased by eliminating weak areas/sectors. We need to install the telemetry system to assess the latest situation of our rivers and reservoirs. Active collaboration with the research Institutes and Universities should be encouraged to integrate modern research with practical field application mechanism. Investment in research sector for better assessment and prediction of drought and flooding cycles is required so that the mitigation measures are taken well in time. Employing experts in the respective fields is very important because the bureaucrats may be very efficient but are comparatively incapable of fighting the case when it involves complex technicalities as it has happened in Kishenganga Dam project.

The military doctrine needs to be redefined which takes care of the affects of the Indian control of our rivers and suggest changes in our defensive and offensive maneuvers. We must appreciate the affects of sinister Indian designs of drying up of our water channels or by intentional collapse of the hydraulic structures and look for a way forward to mitigate these affects.

7.4 Exploring new possibilities

The clock is ticking and if we don't wake up now, it is going to be very late. We need to explore possible sites for construction of new reservoirs in order to store the excessive water which is being wasted annually into the sea. We need to educate the masses how the Kalabagh construction is linked to our survival as it has already completed the planning stage and a lot of financial and material

resources have gone in this project which otherwise we cannot afford to waste. Diamer Bhasha Dam and Neelum Jhelum projects need to expedited to avert Pakistan from turning into a desert.

7.4.1 *Searching Potential Sites*

Extensive research and investigations are required for exploring new catchment areas and new site for construction of water storage reservoirs making use of latest advanced research facilities like remote sensing. In this way we can investigate all those areas which were otherwise inaccessible. We can also resort to construction of small storage reservoirs at local, regional or provincial level depending upon the land availability.

7.4.2 *Capping the Hill Torrents*

We have already exhausted our existing water storage capacity and our water resources. A rigorous and dedicated effort is required in order to explore and develop the resources of water in the form of hill torrents. It is not an easy task because of large fluctuations in the peak and normal flows, large sediment flows and its timings which might not be in consonance with our cropping pattern. Moreover, hill torrents involve high velocity flows which result in erosion. But there is a vast potential of capping this water resource by incorporating elaborate investigation and research in this field.

7.4.3 *Funding Options*

Since Pakistan's economy is already going through turmoil, we need to find out foreign funding options. It is only by effective investigations that we can convince funding agencies like World Bank and United Nations if we highlight this serious disaster which is awaiting us. We need to enhance the diplomatic efforts for persuading the International community the dire need of water resources construction projects.

8. CONCLUSIONS

It is high time that we open our eyes and start working on war footing to avert this looming water crisis which is in the offing for our nation the near future. If we do not employ a multi faceted approach to address this issue and take immediate steps simultaneously at various different fronts, a very gloomy fate is awaiting us rendering a fertile Pakistan into a barren desert like Ethiopia and Somalia. Our coming generations will not forgive us on this criminal negligence if waste this naturally gifted land full of resources. We need to take immediate remedial measures to avert the ominous Indian designs of choking our water resources by taking care of each and every drop of this invaluable resource of water.

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