

**National Rainfed Area Authority
Planning Commission**

Subject:- Climate change resilient out of box solutions of disasters in J&K and Punjab - 2014

Himalayan water tower consisting of glaciers, snow, rainfall and lakes/ wetlands has high potential of flooding being hiked by increasing number and intensity of extreme storms because of climate change. Valleys enclosed by high hills are prone to heavy rains and cloud bursts with rainfall intensity of more than 100 mm/hr. Unlike other areas, more than 90% of rain falling on hard and solid glaciers as well as rocks flows down as run-off and may cause flooding by high rainfall. Incessant rains may also induce melting of glaciers and add to ferocity of floods and deluge. Geologically, J&K is diverse, complex, fragile, risky and landslides are further aggravated by low to medium intensity earthquakes at an average rate of 20 events per year. Encroachment of wetlands, construction of communication network and other developmental activities also add to vulnerability and fragility.

Kashmir is a closed valley and Jhelum river with narrow section flowing through Pir Panjal hills is the only outlet for releasing floods. In spite of heavy inundations in 1841 and 1893, the state was not adequately prepared for evacuation, relief and other responses. However, military, NDRF and some voluntary organisations did good job in evacuating, sheltering, feeding and medication of stranded people. Preventing epidemics, pumping out water and retrofitting of dangerous buildings are the immediate most urgent call.

Robustness against flooding and earthquake resistance of all kinds of communication network and other civil works would require latest art of technologies, designs, material, processes, safety nets, quality checks, convergence of various agencies/departments and rigorous concurrent monitoring and course corrections. Re-alignment of drains, roads, railways etc. with greater use of tunnels, slope stabilization, construction of road side drains and frequent safe landing of storm water requires unique capacities. Soil, rain water and wetland conservation in the arable and non-arable lands will also help in moderating and dissipating disasters. Repairing and renovation of canal irrigation for paddy cultivation in valleys is required. A special policy, institutional mechanism and investment portfolio is called upon.

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Flood situation in Punjab requires altogether different remedies mentioned in the note enclosed. It is high time to adopt out of box solutions to meet emerging challenges of inclusive development, climate change vulnerability and geological fragility.

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Encl: as above

To

1. Secretary, Planning Commission
2. Principal Secretary to PM
3. Additional Principal Secretary to PM
4. Secretary, M/o Road Transport and Highways, Shipping
5. Secretary, M/o Water Resources, River development & Ganga Rejuvenation.
6. Secretary, Department of Land Resources
7. Secretary, Department of Agriculture & Cooperation
8. Chief Secretary, Srinagar, J&K
9. Chief Secretary, Chandigarh, Punjab
10. Chairman, NHAI, Delhi
11. Chairman, Border Roads Organisation, Delhi
12. Director, Central Road Research Institute, Delhi
13. Director, Wadia Institute Himalayan Geology, Dehradun
14. Director, IIT, Roorkee, Uttarakhand
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Malady and remedy analysis of floods in J&K and Punjab - 2014

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Highly anomalous rainfall storms and shifting of their distribution is now an internationally admitted manifestation of climate change induced by indiscriminate industrialization, urbanisation, consumerism and other factors. Occurrences of floods outside the traditional States of Bihar, Assam, Eastern UP and Orissa have increased due to higher frequency of extremely high intensity rainfall storms. Many times clouds entering into the valleys are not able to escape because of high hills, go on accumulating and ultimately burst into a high intensity rain. Mud flow after midnight cloud burst on 6th August, 2010 in the otherwise cold desert of Leh killed 255 persons and damaged 71 towns/villages and several vital infrastructures. More than 2 million people were affected as torrential rains lashed Orissa, UP and Bihar in September, 2011. Flash floods and landslides triggered by a sudden cloud burst in the midnight of August 3, 2012 in Himalayas left 31 persons dead and 40 missing. In the last year of 2013 rainfall arrived Himalayas 15 to 20 days in advance and a cloud burst on 16th June caused extreme flooding, deluges, infrastructure damages, deaths of human beings, livestock, wild life and loss of biodiversity in the *Chardham* region of Uttarakhand, Kinnaur valley of Himachal Pradesh and South-West Punjab around Muktsar Saheb District. *Chorabari* glacial lake above Kedarnath burst and added to the ferocity of cloud burst and flash floods. Out of the entire Himalayas, maximum number of glacial lakes, vulnerable to climate change, bursting and flooding are there in Beas, Sutlej and Chenab basin.

In the current year of 2014, monsoon arrived about six days late in Kerala and its progress towards north India was very slow, its further movement to North remained stuck up for about 15 days over central India and extreme drought situation prevailed in the states of Punjab, Haryana, Gujarat and Maharashtra. In the fag end of monsoon withdrawal (week ending September 3, 2014), J&K received 55% excess rainfall, Western Rajasthan 33%, Eastern Rajasthan 34% and was deficient in Punjab (-63%) and Himachal Pradesh (-48%) over the normal. However, North-west region, especially J&K, received incessant excessive rainfall during 3-6 September, 2014 because of the development of a deep depression and

joining of moisture coming from the Arabian sea to that of originating from Bay of Bengal and became a unique case of westerly disturbances. On 5th of September, 2014, J&K received 3176 % and Punjab 534% excessive rainfall over the normal.

Shopian district of J&K received 2953%, Kupuwara 1984%, Kulgam 1850%, Anantnag 1687% and Baramula 1489% excess rainfall over normal in the week ending 9th September 2014. All 21 districts except Punch received high rainfall. The glaciers and hard rocks produced lot of run-off, the soil of the region was already saturated and incessant high rainfall for four days generated unprecedented floods. It also breached Jhelum river, eroded banks of other rivers, damaged communication, other infrastructure, caused deaths of human beings, livestock and wild life. Gates of some reservoirs of Kashmir were opened to save dams, water in Tawi, Chenab, Jhelum and other rivers flowed above danger mark. About 400 villages were inundated, damaged or destroyed and four lakh people stranded in Kashmir valley. The valley of Kashmir was inundated earlier in 1841 and 1893 also. After that, marshland reduced by 52% and water bodies by 23% in 103 years i.e. during 1911 to 2014 and cushioning of floods was lost. Excessive water saturation of soils caused landslides in hills, blocked as well as washed away roads and bridges which led to collapse of all kinds of communication and posed many difficulties in rescue and relief operations. Jammu region was also flooded but recovered soon. J&K government was inadequately prepared to respond to this very unique flood situation in a closed valley.

The second situation is of South West Punjab i.e. Malwa region where ground water table is very shallow, there is hardly any rain water absorption capacity of the land and has become flood prone. Drainage system is inadequate and damaged the almost matured crops of cotton, rice and some infrastructure.

The third flood situation is of Majha region of Punjab where there is very good surface drainage system, deep and declining ground water table and excess rainfall is expected to recharge over exploited aquifer. However, damages to almost matured rice crop were noticed in the low lying depressions all along the drains and *Mand* (river bed) in the downstream of Beas and Sutlej river basins.

Keeping in view the above three distinct flood categories, their diverse topographical, geological and socio-economic environment very innovative, out of box and region-specific solutions are called upon.

1. Jammu & Kashmir

Glaciers, snow and rainfall make Himalaya as a great water tower for supporting life and livelihood of millions of human beings, livestock, wild life and biodiversity especially in downstream also. However, hills are young, seismically active, fragile, diverse, complex and highly vulnerable to climate change. Kashmir is an enclosed valley and Jhelum river originating at *Verinag* spring is the only flood water outlet. It is an ancient river and is known by different names such as *Vetasta* in Rig Veda, *Hydaspes* in Greek and *Vyeth* in Kashmir. Its total catchment up to Indo-Pak border is 37,775 Km² (17.4 times of Tawi) and about 51% (17,622 Sq.Km.) is in Kashmir valley alone. Its length within India is 402 km (2.8 times of Tawi) and about 50% of its annual flow is contributed by glacier melt. There are 5253 glaciers in J&K as compared to 2786 in Himachal Pradesh and more than 95% of monsoon rains falling on them and hard rocks join the rivers network as surface run-off with high potential of flooding during excessively high intensity storms. In the ancient time Srinagar city area was a lake or a part of wetland network. Wullar, Dal and other lakes used to hold excess storm water and release into Jhelum during off season. However, most of the wetlands got silted up, encroached and lost their storage or flood moderating function. Incidentally Tawi river originates from Kali Kund glacier in Doda district with relatively small catchment of 2,168 sq.km and small length (141 km) as compared to Jhelum. After Wullar lake, Jhelum crosses Pir Panjal range through a deep very narrow gorge (about 2100 meter deep) with almost vertical or even hanging rocks and is a bottleneck for quick discharge of flood water.

Normally storm water disappears very soon after the rains in the rolling topography of hills and it was other way round in J&K. May be that reckless constructions along the banks of Jhelum and elsewhere has strangulated the natural drainage network and water will stagnate in local depressions even if water level in Jhelum goes down and would require pumping out. J&K is seismically active zone and normally experiences about 20 earthquakes in the range of 3.3 to 5.4 on Richter scale which further deteriorate its fragility and vulnerability to landslides and mass erosion of soil. Accordingly all tele-communications and transport systems of the fragile hills and mountains are highly vulnerable, it requires very unique strategy of rescue and relief as well as re-construction and rehabilitation operations. Frequent landslides, erosion of river banks, washing away of roads, rails, bridges, houses and other infrastructure is a very challenging job of reconstruction, rehabilitation, restoration and mitigation or moderation of floods in Jammu & Kashmir.

Robust or resilient construction or re-construction of roads, bridges, railway lines, other civil works and communication infra-structure is very vital both for inclusive development and security reasons of this border region. This requires a lot of coordination and convergence of the departments like Public Works, Border Roads Organisation, NHAI, Railways, geologists, hydrologists and engineers for designing and selecting of most appropriate technologies, construction material and integrated implementation. Input of structural and hydro-geologists for stabilising slopes, landslides and road/rail side drainage and safe landings of run-off water should be made mandatory. The writer has seen the performance of a World Bank constructed road in high rainfall Mizoram hills during the rainy season of 2013. Easing of slopes, stone pitching of slopes, construction of stabilization structures, meticulously designed drains towards the hillside and frequent safe landing of the run-off into the valleys have made a major difference in minimising the landslides to ensure un-interrupted services under all weather conditions. One can also see the performance of a privately built toll road from Chandigarh, bypassing Pinjore to Simla and there are many lessons to be learnt by all those who are engaged in the road construction or re-construction works in the hills. Central Road Research Institute (CRRI), Delhi has alternative technologies of unique materials, processes and implementation for addressing high vulnerability of the fragile and complex Himalayan landscape. Discussions with Border Road Organisation, IIT Roorkee technocrats and others revealed that there is a lot of scope of tunnelling technologies in India. Tunnelling should be considered an important option for re-aligning roads and railways for providing services even during diverse weather and seasonal conditions. This whole integrated approach has to be relatively more expensive but will be worth doing in the long range perspective of miseries along borders and increasing number of events of high intensity rains and cloud bursts. Rigorous concurrent or on-line monitoring, evaluation and periodical course corrections during implementation should be a part of the bidding process. Testing of quality of construction material by an independent third agency like that of in Pradhan Mantri Sarak Yojana should be mandatory.

Communication network and electric supply also collapsed and handicapped evacuation of lakhs of stranded people, relief and quick response to the calamities. A diverse, dedicated, robust and reliable telecommunication system based on satellite, power backup and submergence proofing would be required.

Unfortunately J&K does not have river monitoring and flood fore-warning system specifically provided in Indo-Pak treaty. Central Water Commission (CWC) along with some

IITs and wetland experts should carry out detailed survey of drainage network, identify bottlenecks and suggest remedial measures for the unique situation of Kashmir. It is a very critical issue because there is only one flood water outlet of Jhelum river, a lot of civil constructions like houses, roads etc. is taking place along it and extreme rainfall events are going to multiply due to unabated global warming. The state should come out with preparedness plan, required policy, institution and capacity building.

Retrofitting of dangerous buildings, flood zoning, relocation of buildings very close to the river banks, strict regulations to check future interferences with drainage system, restoration of wetlands and river training works will be able to minimize infrastructural damages and human miseries.

Safe disposal of human, animal and wild life carcasses, immunization of human beings, vaccination of livestock and animal health care are uppermost to avoid epidemics. Rejuvenation of damaged orchards, fish seeding of water bodies and contingency plan for alternative crops is very essential to compensate losses in agriculture production. It would also require a massive dose for conserving land and water both in arable and non-arable areas under Integrated Watershed Management Programme (IWMP) of the country. Repairing canal system is essential to restore irrigated paddy cultivation in the valleys.

2. South West Punjab (Malwa)

The districts of Muktsar, Mansa, Bhatinda and Faridkot normally receive lowest rainfall in the range of 286-296 mm which is 2.6 times less than 765 mm in Gurdaspur. This region was listed in the British records as Crown Wasteland because of its aridity, sand dunes, very deep (40-50 M) water table, poor vegetative cover and cultivation of coarse cereals. Introduction of canal irrigation led to massive land levelling, diversification to cash crops of cotton and water guzzling paddy, rise in water table almost up to surface (1-2 M below ground) and accumulation of salts in the upper soil layers. Seepage from the Indira Gandhi Canal, Sirhand Feeder system, inefficient irrigation and obliteration of the natural drainage by land levelling, construction of canal network, roads, railways etc. also accelerated rise in ground water level and land degradation. Poor quality or high salinity of very shallow ground water has weakened even boundary walls of houses and other civil works are also being eaten away by the salts. As a result of that the soil cannot hold even one storm of high intensity rains and needs efficient surface and sub-surface drainage. There is also a big question mark about the outfall of drained water because of its unique topographic

location. Drains discharging into Ghaggar have been blocked at Haryana boundary and rise in water level in Sutlej river during flooding locks up discharge of other drains into it and cotton cannot withstand more than three days submergence. It, therefore, requires preventing all kinds of seepage losses from irrigation network, most efficient application of water with drippers, sprinklers, ridge and furrow method of irrigation and diversification into livestock, fisheries, agro-forestry and others which are resilient to flooding and water stagnation and water logging.

Flood fore-warning system and meticulous regulation of the canals during rainy season is very essential in the state of Punjab. Even in 2014 there was breach of Uddak branch in the Mansa district where the water continued to be released into the system in spite of very heavy rainfall. Damages to the cotton crop, houses and other infra-structure could have been minimized had the canal water regulated at the most crucial time. There is no dearth of communication now a days since the instruction can be passed almost on real time basis on mobile etc.

3. Majha

Fortunately this region has very good quality ground water which is being extracted excessively for raising water guzzling rice and high intensity storms provide opportunities of re-charging and also curtailing demand of ground water. There is very good drainage network and could be harnessed for re-charging. However, the depressions all along the drains and *Mand* (river beds) got flooded and would require a very unique farming system which can withstand periodic water stagnation during extreme events of high rainfall. Risk associated with untimely rains especially when standing crops are matured or if grains quality is adversely affected may be insured appropriately. One could also consider more emphasis on animal husbandry, processing of milk, value addition and efficient marketing system for *Mand* area and all along the drains. Plantation of commercial trees like Poplar and Eucalyptus can also withstand water inundation and provide resilience against the risks both in Malwa and Majha. However, marketing of the soft wood is highly volatile and calls up on stabilization of prices as good as or even better than rice and wheat.