WELCOME ADDRESS

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Union Minister of Water Resources, Shri Vidyacharan Shuklaji, Minister of Industries Himachal Pradesh, Shri Kishori Lal ji, Shri H C Bhardwaj, Member, H.P.S.E.B., distinguished guests, delegates to the Symposium, Ladies and gentlemen.

It gives me great pleasure to welcome you all at the inaugural function of the International Symposium on Hydrology of Mountainous Areas. We are extremely grateful to Shri Vidyacharan Shukla ji, Union Minister for Water Resources for having spared valuable time to be present on this occasion to inaugurate the symposium. There could not be any person better than him to inaugurate the symposium in view of his great concern and directing with distinction the water resources development in the country. I am also thankful to Shri Kishori Lal ji, Minister for Industries,Govt. of Himachal Pradesh to kindly agree to preside over the inaugural function. His participation in the symposium speaks of the great importance the Govt. of Himachal Pradesh attaches to the development of Water Resources.

The symposium is sponsored by Unesco and Himachal Pradesh State Electricity Board besides many other organisations including the International Water Resources Association and IAHR. At this symposium, 57 papers on various aspects of Hydrology of Mountainous areas covering hydrometreology, measurement techniques, modelling of snow and glacier melt, sedimentation processes and environmental aspects, modelling of hydrological processes in mountainous areas, management of flood, groundwater and spring flow will be discussed. Out of these papers, 18 papers have been received from USA, Canada, Italy, Turkey, Czechoslovakia, Russia, Uzbekistan, Nepal, Sri Lanka, Bangladesh, Iran and Indonesia. Most of the authors both from India and abroad are likely to present their findings at the symposium.

Mountainous regions particularly the Himalayas have always attracted the attention of scientists, engineers and geographers from all over the world. One and all get thrilled with the scenic beauty and the serenity of the environment. The scientific investigation have so far been very limited due to high altitude and associated communication and transportation problems. However, the scientific understanding on the subject has been developed in this environment, the availability of new tecnology especially remote sensing by satellites and automatic instrumentation with developed data acquisition systems now seems possible to assess the water resources of the mountainous regions.

The great Himalayan range between the eastern extremities of Burma and western extremities of Pakistan is highly rugged with the horned peaks, serrated crests of ridges, cirques and hanging glacial valleys and cascades of gushing icy water through deep canyons. The mountain system spreads over a range of 2500 kms in the east-west direction and width varying from about 200-400 kms in the north-south direction.

The existence of snow and ice is an important source of water and cheap hydroelectric power. The glaciers provide an effective and economic means of storing water in high mountainous which is accumulated in winter and releases in summer. In the Himalayas

there are about 1500 glaciers forming a unique Water storage system covering an area of about 30000 sq.km. The mountainous areas covered by snow is about 80% of the total area of Himalayas.

Snow and glacial melt contributes a significant portion of the spring season flow in the Himalayan rivers. The precipitation during the winter months is about 40-50% of annual precipitation in the western Himalayas though it is only 3% in the eastern Himalayas. Monitoring of depth and water equivalent of snow received during winter months of crucial importance for estimating the spring season flow. The snow depth and snow water equivalent in the water are presently monitored by India Metreological Department, Snow and Avalanche Study Establishment, Bhakra Beas Management Board and Central Water Commission.There are in all about 115 snow monitoring stations of these organisations. All these are located in the western Himalayas. There is hardly any snow monitoring station in the eastern Himalayas.

Normally there should be one observatory for snow cover monitoring for each basin to 10000 sq.km. The observatory should be manned by a team of trained personnel and equipped with instruments capable of observing most of the hydrological parameters or there should be an automated hydrological station at these locations which should provide the data to a central station.

It is, therefore, necessary to set up around 150-200 automated weather station with snow sensors in different basins of the Himalayas.

Basic requirements for understanding and proper management of high mountain water resources require an indepth knowledge of the amount and location of stored frozen water, the patterns of water release by melting and knowledge about how these parterns of release depend on short term whether long term climate change.

Using of remote sensing in the visible thermal and microwave region can play an important role in monitoring of snow and glacial regions. As the problems of communication, logistics and manpower development on a continental basis are instrumentable for monitoring high Himalayas, un-manned data collection are required for sensors and monitoring of snow systems.

For the last three decades, a number of isotope techniques are in use for the study of snow and ice for determination of water equivalent of snow cover, location of ice lenses in snowpeaks, regional snow surveys, determination of snow accummulation over a glacier melt, contributions to river flows.

Springs are natural and important resources of water for remote hilly terrain, where other conventional water resources

are difficult to develop. There are many springs in the Himalayas western ghats and other region in India which have to be studied and mathematical models developed for spring flow estimation.

There are a number of fresh water lakes in high altitude regions in Jammu and Kashmir, Uttar pradesh and Sikkim etc. These can be developed for water resources in hydropower development in these regions.

Soil erosion and sediment yield are very critical problems for India and particularly for the mountainous regions. This is further aggravated by improper land use and management practices being adopted in the upland watersheds. These influences are more severe if the top fertile soil is eroded. Mathematical modelling of watershed resources with proper emphasis on hydrological response need to be developed so that proper land use policy can be evolved with a suitable system of soil and water management with due consideration of increased water yield.

The approach to flood estimation in mountainous region are somewhat different from that applicable for plains. This is due to steep slopes , orographic effects on precipitation, runoff caused by movement of rainfall water , snow and glacial melt.Due to shallow soil mantle and glacial melt most of the part of the precipitation is converted into runoff and interflow. Since the runoff of mountainous watersheds is contributed by rainfall,snowmelt and glacial melt, the estimation of flood is from mountainous watersheds would correspond to either rainfall,or snow and glacial melt or a combination of these two.

The procedure of estimation of design storm and design flood in mountainous areas differ from that of the plain areas. The transposing storms from plains to high mountainous barrier is dubious because of the dynamic influence on storm of the mountain. It is,therefore, necessary to undertake a total storm depth area analysis in the project basin for each winter storm and to determine the storm dew point and maximisation factor approriately and using the appropriate time area, type of models, design flood can be estimated.

These are some of the problems which are important to all hydrologists world over and I am sure that the papers presented in the eight sessions at the symposium will lead us to a better understanding of the hydrological problems of mountainous areas and solutions thereof.