SOME ASPECTS OF FLOOD CONTROL WITH REFERENCE TO NORTH WEST BIHAR

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INTRODUCTION:

Before, the emergence of new socio-economic culture, floods were momentous phenomena. They come and go in quick succession. Earthquakes of 1834 and 1934 caused a sort of depression almost in the major part of North Bihar and this resulted in congestion of drainage system of the area. Unmanaged urbanisation and settlement and indiscriminate development of industries in areas liable to floods acted as an increment to the problem of floods. As a result, whenever high magnitude floods occur, the damage is considerably devastative.

According to the Draft 11th Five Year plan of India, "the progressive increase in the damage due to floods can be attributed to overall reasons : (a) The mounting pressure on land from over increasing population which induce people to occupy, build, and cultivate on traditional ponds, depressions and 'Khaddar lands', (b) the role played by the development works such as roads, railways, canals, etc., firstly by exposing more public property to damage and secondly by accelerating damaging capability of waters by transforming sheet flows into concentrated flood through culverts, siphons, bridges and aqueducts, etc. The flood control measures have, therefore, to keep pace with the general tempo of economic and other developmental activities. Consequently, the damage and loss of life due to floods are increasing year after year, when floods are so problematic in the flood plains, it is important to ask why man continues to live in and to exploit flood zones. Some analysis's favour occupying flood zones because of the fact of its advantages. But other group of analyses take floods as the creeping enemy which are bent upon to swallow the progress of humanity. So it is a complex problem and to judge its results in concrete term, is not an easy task.

Keeping in view the various aspects of floods and drainage problems 'in the flood plains, the National Commission on Agriculture, 1976 and 2nd Irrigation commission 1972, GOI, have separately put emphasis on need to associate drainage as an integral part of an irrigation project second Irrigation Commission, 1972, G01, has observed, "An area once damaged by water logging (due to any factors) and salt efflorescence is difficult and costly to reclaim. We, therefore, urge that in formulating irrigation schemes, the instructions clearly issued in respect of making adequate provision for drainage should be strictly enforced." Drainage of irrigated areas should, therefore, form a part of irrigation projects.

In India, although the importance of irrigation and development thereof had been realised by Government since long, but it' is only during the last 100 years that the problem of flood control has been engaging the attention of the Government. Reference may be made about some of the important reports of Flood Committee and experts submitted earlier in respect of North Bihar

(a) Proceeding on the Committee formed to consider the material collected by waterways engineers concerning flood conditions in North Bihar, 1937.
(b) Report of C.c. Ingles, 1941.
(c) Comprehensive treaties on North Bihar Flood Problems giving a description of the river system, their behaviour and tendencies with suggestions for flood mitigation by RC. Ghosh and K.K. Sahay, 1942.
(d) Report on field trip of flood control in North Bihar by B. E. Tarpon and Clarence Raw house, Dec., 1954.
(e) Report on a Reconnaissance of Flood Control Problems in North Bihar by Luna B. Leopold and T. Maddock Jr., April, 1955.
(f) Report on the High Level Committee on Floods, Vol. GOI, Ministry of Irrigation and Power, New Delhi, 1957.

Besides these more than sixteen other deliberations on the subject took place between 1937 and 1957 on the specific part of the river basins of North Bihar. But despite of all these attempts there had been no seriousness of the problem on the part of the British Government. .It is only after the advent of the own popular Government the problem of flood control has been considered as one of the pre-requisites for the scientific development of irrigation.

After independence a new approach was taken for this purpose. Captain G. F. Hall, the then Chief Engineer, P. W. D., Bihar in a forward to the book entitled "A Comprehensive Treaties on North Bihar Flood Problem", published by GOB, in 1948, observed strongly depreciate the expression 'devastating floods', which has become the common phrase for describing floods causing temporary inconvenience. In North Bihar, floods are as inevitable as they are essential. Taking the broad view, they are definitely beneficial." His further observation is also interesting to be quoted here "North Bihar can't do without floods. The problem is not to prevent floods, which has been the erroneous idea in the past and which has led to the promiscuous of the havoc now caused by floods, but to give them an easy run-off. The evils of bund is manifold The only justification for bunds (except for local protection of urban areas) assuming a flood was undesirable, is along both banks of river which has no tributaries In the old days whenever a flood problem arose the answer was led us build a bundh. A famine relief work, which frequently comprised the erection of bunds, was in no small measure responsible for the present trouble". The above extract of Captain Hall clearly exposes the line of thought and action of the then British Government regarding the problem of floods.

Genesis of Flood Control Board

In 1954 a major part of India experienced a severe flood. Realising the grim situation Pandit Nehru, (P.M.) instructed to constitute a Central Flood Control Board in 1954. It was reconstituted in 1965 and in its light; simultaneously State Flood Control Boards were also set up. The functions of the Central Flood Control Board are summarised here:

(a) To lay down the general principles and policies in connection with flood and flood control measures;
(b) To consider over the matter of Flood Control Plan as submitted by the State or the River Commission; and
(c) To arrange for necessary assistance in connection with investigation planning and execution of flood control work.

The functions of the State Flood Control Board and of the River Commissions (Floods) are almost the same and these are co-ordinate with each other. The Flood committee of GOI authorised "the N.C.A.E. to carry out a polite survey in selected areas North Bihar and evolve a standard scientific procedure for assessment of flood damage". It was also pointed out that the technique prescribed by it, should be applicable "Not only in North Bihar in years to came, but in other states as Well in putting the assessment and collection of flood damage on an uniform basis throughout the country.

Flood Control Measures

It is well known fact that floods are natural phenomena and its control can be achieved only within limits. Flood control measures involve structural engineering measures adopted in response to flood hazard. The objective behind any such measures is either a reduction in the area of floods or reduction in the depth of flood waters or a reduction in flood discharge. Prof. R. Ward in his book "Floods- Geographical Perspective" has suggested the following four main measures for the sake of flood control which are in use in most of the countries being ravaged from flood hazard:

1. The construction of embankments and flood walls to confine the flood waters;
2. The improvement of the river channels to enlarge their discharge capacity for example by strengthening, widening Deeping.
3. The construction of by pass and diversion channels to carry some of the excess flood water away from the floods area;
4. The construction of reservoirs for temporary storage of flood waters.

By applying the above mentioned four measures the flood's effect may be modified~ Modification of flood involves a number of measures such as physical control, land use modification of the catchment or alteration of precipitation patterns through weather modifications. It aims at alteration in:

(a) The volume of runoff
(b) The time taken to attain the peak
(c) The duration of flood,
(d) The extent of area flooded
(e) The velocity and depth of flood waters, and
(f) The amount of sediments and pollutants that the floods usually carry.

All these alteration can be done by means of the applications suggested by Prof. Ward.

Embankments/Flood Control.

The embankments and flood walls are the most common, quickly constructed and economical means of flood management structures which serve as artificial high bank of the river during floods and keep the water away from the threatened area. They are easily constructed and provide immediate relief. Their usefulness is enhanced when they perform in conjunction with flood moderation by reservoirs. However, these are faced with some problems and side effects as outlined below which may have been be kept in mind while planning flood management works-

(i) Effect on land being deprived or fertilizing effect of silt;
(ii) Effect on river regime by enabling the River to carry on increased silt loads;
(iii) Reduction of cross-sectional area of flood often when embankments and floods walls are constructed close to the river bank and parallel to its course;
(iv) Cutting off of valley storages by preventing from spilling over a part of the flood plains otherwise available for moderation of the flood;
(v) Problem of aggradations, demanding progressive rising of the embankments;
(vi) Effect on country side drainage, by blocking the natural drainage;
(vii) Drainage congestions as tributary junctions due to jacketing of the tributary to prevent the back flow spill of the main rivet;
(viii) Vulnerability of embankments to river action involving costly anti erosion works at vulnerable points to hold the river.
(ix) Vulnerability of embankments due to deficiency in planning construction, when they are take up as an urgent measure and are completed in short time.

The history of embankments as a remedy of flood control dates back 7th century BC. In the case of China and even earlier in India. The river Gandak, the river Baghmati and some other rivers in the region have extensive embankments. In recent time embankments have been in existence along the Gandak River for about a century now.

A number of committee constituted in various countries as well as in India have deliberated upon the utility of embankments as a means for flood protection. Extreme views have emerged out as a result of such deliberations. One is that all problems of flood can be solved by demolition of all the existing embankments and the other diametrically opposite view is that taking recourse to more and more lengths of the embankments is only practicable solution of flood problems.

The reason for such diversified opinion is obviously due to the divergent views on the performance of the existing embankments as experienced by different experts. No doubt, some embankments have provided wonderful protection from the deluge of floods, while as, some of them have aggravated the flood problems. The primary reasons for these experiences of divergent performances are basically the very reason, due to which the embankments become the most popular measure for flood protection i.e. its relative cheapness in construction and simplicity in planning. This apparent simplicity creates an illusion that no technical considerations are needed for planning and construction of embankments and that their maintenance is not a matter of importance. The consequence had been that against one category of well-planned, properly constructed and well maintained embankments, there exists another ill-planned, improperly

constructed and ill-maintained embankment. Thus, the experience of the performance of the embankments depends basically on the factor as to whether the opinion is based on the first category or the second category of embankments. As such it is suggested that performance of some of the existing embankment schemes be got evaluated and result of such studies be deliberated upon by various experts including environmentalists to arrive at practicable solution in the circumstances existing in the state.

Reservoirs/Dams

It is another method applied for the moderation of floods. It is seen that severe storms cause floods of high magnitude. But when the storms die the flood also subsides within a reasonable period. This fluctuation is taken advantage of for moderating the flood through reservoirs. During the period of high discharge, water is stored in storage reservoir and released when the critical conditions are over.

But the construction of large reservoirs only with the purpose of flood protections is not economical. Therefore, multipurpose reservoirs should be constructed that direct benefits such as irrigation, water supply and power generation along with flood moderation may be achieved. The effectiveness of the reservoirs would depend upon the capacity available for absorbing flood runoff. As multipurpose large reservoirs would be used by many users, and the period of peak uses would differ for different users, so a compromise has to be stuck to obtain the optimum utilisation of water.

But the Indian conditions of building large reservoirs are not so simple. Constraints like Geology, seismic and topographic conditions in the Himalayan Rivers, seem to be one of the reasons for retarded progress. The problem of excessive silt, limiting the life of proposed reservoirs in some of the Himalayan Rivers, could be another factor. Hence, to pursue the National Policy of providing floods. Moderation through this way on the tributaries has not been effective and would not be possible in our future programme. On behalf of it, the concept of watershed management, channel improvement and avoidance of encroachment of river water way should be incorporated along with the programme of flood moderation through reservoirs. The D.V.C. in Jharkhand state and the Hirakund reservoir on the river Mahanadi in Orissa were done applying this method to control the ravage of the notorious river Damodar and the Mahanadi respectively. But for region, its construction cannot take place in the region itself. It involve the Nepal Govt. and the Majesty of Indian Govt. whatever be its efficiency, the report of the Irrigation Commission of India in 1972, may be cited here for perusal- “the best way to control floods is to intercept them with storage reservoirs so that only moderated floods are allowed to flow through the valley below”.

Emergency Gate-ways

Emergency gateways are temporary diversion to take excess water away from the river by providing pucca spillways siphon off flood flows above predetermined level. The disposal of such flows has to be prearranged into lakes, detention basins or onto land. Fuse pulse are sometimes used for lowering flood peaks. This takes the shape of certain length of the embankment being kept lower or so Constructed that at a predetermined level, failure will take place. Thus lowering the level and pressure of water on the embankment. It has however to be kept in view that it is almost impossible that an automatic failure of a fuse plug will take place, because by the time it may be needed. The section may have got so consolidated as to make the fuse plug in effective. Spillways at predetermined levels may perhaps be a better proposition.

Following considerations must be taken care of while taking up such measure:

(i) The area where flood waters are to be almost free or habitation
(ii) The area should be protected by secondary embankments for preventing the flood waters spreading in all directions.
(iii) There should be reasonable drainage facilities to take back the flood water into the river when Flood over.

Channel Improvements

Any increase in the cross sectional area of a river channel or in rate of flow of water through the channel will, for a given discharge result in a lowering of the water surface and a cross pending reduction of the flood hazard. The method of flood protection is normally achieved through one or more of the following approaches:

(i) Improving the cross-section by widening, deepening or making the section more regular.
(ii) Channel clearance whereby all local obstructions 1n the bed or on the sides are removed.
(iii) Strengthening the channel, thereby improving flow conditions in the channel.
(iv) Cut offs which reduce the length of the channel, give it a steeper grade and consequently higher velocities and lower flood heights for a given discharge.
(v) Lining the channel. Thereby improving the co-efficient of rugosity, and thus enabling the river to pass greater discharge for the same water level.

River diversions

River diversions could be temporary or permanent. A temporary diversion could be in the form of bypass, saving urban areas from high floods. This envisages taking off a channel upstream of the area in order to reduce the peak flood and bringing it back to the same river downstream. This method has been adopted a number of places on the Mississippi river in USA.

A permanent diversion would mean taking part of the flood, away from the stream into another stream or to a depression (to be used as a detention basin) or to take. This would lower the flood flows downstream of the off-take. The method of reducing the flood peaks by diversion to detention basins has been successfully used in the Jhelum River near Srinagar.

The diversion need a channel and in most cases, embankments in flood plain which would use agricultural land even though temporary for the duration of the functioning of the channel. This could be expensive as well as sometime not even possible. This factor has to be kept in mind while considering this measure.

Inter Basin Transfer

It involves diversion of water from one stream of the basin to an adjacent stream or drainage basin. This method is economically feasible in cases of small streams and where the watershed is separated by flat ridges, because otherwise huge excavation or tunnelling through the ridge is involved in case of larger streams.

This measure can be used as substitutes for embankment or flood walls wherever urban developments are concentrated near the channel banks.

Inter basin transfer concept in India for flood moderation purpose has not yet come to reality. Whereas, it has been extensively used in USA. In the lower Mississippi valley and in the Sacramento River valley.

Bank Stabilisation and Anti-Erosion Measures

To check the tendency of eroding and damaging the new area the river is trained by adopting these measures. In this method the current is deflected away from the area or the structure under attack by the river. But these works sometime shift the problem either upstream or downstream which may affect either bank. These works involve high capital and maintenance cost.

The Rashtraiya Barh Ayog while dealing with this method in its report submitted in 1980 (Para 14-15) agreed with the resolution adopted in the Fourth Irrigation Minister Conference which states that the anti-erosion works should normally be taken up only for protection of towns, industrial areas, group of thickly populated village abides, railway lines and roads where relocation is not possible on socio-economical grounds. These works should not be taken up for

protection of agricultural arms where assets protected may not justify the cost. In such cases rehabilitation affected population and assets elsewhere should be considered.

In its reports submitted in December 1988 the Committee Flood Management in Eastern states has also recommended as such.

While dealing with the erosion problem of different areas I spots I reaches of a river due consideration to the adverse effects likely on the downstream and opposite bank should be given.

Anti-erosion works should be taken up with extra caution in inescapable cases, after carefully judging their necessity as per the prescribed guidelines and criteria.

Ring Bunds

An earthen bund around habitation tagging it with high bank ground is constructed to keep the flood water away. This ring bund keeps the habitation free from inundation during floods but the rain water which accumulates within this bund needs to be either drained out or pumped out. These ring bunds combined with main bund may function as a spur projecting into the flood away. Therefore, before planning this measure, its likely adverse effects have to be duly considered.

Drainage Improvement

Construction of new channels or improvement in the discharging capacity of the natural drainage system is carried out for removal of drainage congestion. Increased drainage may cause wastage of valuable water. It should be thus, utilised for irrigation purposes by taking it to some irrigation system lower down.

Sometimes drainage improvement causes drainage congestion in the downstream, so it should be planned and executed in a coordinated manner starting from down streams.

Sometimes drainage congestion occurs behind embankment which cash be removed by construction of channels parallel to the river to discharge it on the downstream where the river level Permits.

Excess irrigation causes rise in water level and consequent water logging. It is therefore, essential that measures for drainage and irrigation are considered as an integral part of any programme.

Sometimes drainage congestion occurs at the crossing of two roads, railway artificial channels etc. or at the crossing of either of these with the other suitable water way for removal of drainage congestion if any. At such crossings invariably provided.

Underground Water Storage

Measures of increasing ground water recharge are advantageous in reduction of flood run-off. This may be done by spreading water in shallow basin and recharging through wells. This additional water, stored in the ground water reservoirs, can be utilised in dry periods.

Although the applicability of artificial ground water recharging methods for flood moderation is yet to be tested and established, research and development should be carried out and incorporated in the future flood management plans.

Abatement of Flood by Watershed Management or Soil Conservation Measures

Abatement applies mainly to river floods which arise in the watersheds or rivers. Causing any delay in the quick runoff of waters or attempts to hold the same is, therefore, considered a useful measure of abating flood volumes. Watershed management is the solution for this; Bare catchment not only results in quick run-off but also in erosion of land. The latter besides resulting in blockages of the river channels and situation of reservoirs, reduces the land capability

due to loss of top soil. Vegetal cover binds the soil and leads to reduction in surface run-off by absorbing water in the soil and subsurface layer and thus the flow period is spread resulting in Lowered peaks.

The programme of a forestation, better forest management and elimination of shifting of cultivation will be useful in serving this purpose. Therefore, it is important to manage the upland watersheds of all streams whether they are flood prone or not as they yield long term effects in conserving soil and improving the quality of land.

Both soil and water conservation can also be achieved by small storages in the catchments which can also be used as agricultural integrated soil and water conservation schemes have been undertaken in various part of the country.

The State Irrigation Ministers Conference held in February, 2016 passed a resolution noting and endorsing the policy that soil conservation programme would be complementary to the Engineering programme of Flood Management and should be taken up simultaneously. However, the watershed management programme have no significant effect in the reductions of flood peaks in the large damage producing floods, but help in reduction of the silt in the river seems to be the background of the above view. Taken, all in all, however, soil and water conservation and aerostation of catchment areas is definitely beneficial.

Modifying Flood through Weather Modification

Redistribution of the precipitation both in respect of time and space is attempted in this method which reduces the risk of high floods in a given area though not directly a method of flood management, the subject has entered into picture in recent times. For determining the possibilities of altering the Weather, researches are going on in various parts of the world but still it is more a concept than a reliable means. Assuming that it is possible it is difficult to judge that the overall cost of this application would be lesser in comparison to Overall gains. Redirection of storm may decrease the damage in certain area but it may increase in the other. Certain area may be deprived of rain. This subject bristles with many factors like political boundaries, effect on ecology and heavy cost. For the time being this is considered as an insignificant part of the flood consideration. It is; therefore, felt that this method may not be applicable to the region concerned.

A Combined Approach

Various methods have been discussed above in isolation. Therefore, it is essential that. Coherent approach should be adopted in order to mitigate the flood hazard. On this line one of the world's most successful of the major flood protection projects, for example is the combination of reservoirs, channel improvement, flood embankments and flood abatement developed by the Tennessee River Valley Authority of the USA. In India D.V.C. was taken up and later on many other projects were also carried out. The Gandak Command Area Development Authority has been adopted on this line. It is hoped that if sincerity prevails upon the administration, this project would surely win over this problem sooner or later.

Damage Estimation & Flood Forecasting

It needs hardly be emphasised that rivers uncontrolled are greatest engines of destruction, but controlled are the greatest beneficiaries of mankind. Irrigation facilities and generation of hydro power are two important effects of the control of the fury of rivers. Floods and deposition of sheet of sands are two most negative effects of the uncontrolled rivers.

Damages caused by the fury of floods are multifaceted. Destruction of standing crops, sweeping loss of man and property, washing off roads, bridges and railways, collapses of houses and disruptions of transport and communications area are various manifestations of the fury of floods. It has been recognised that absolute or permanent immunity from floods damage is not physically attainable by the methods of flood control as discussed earlier.

From preceding paragraphs it is obvious that the region under perusal has, on an average, ' slightly more than 65000 hectares flood affected land. The C.D.B.'s falling under the influence of the river Burhi Gandak or Sikarahna and The Baghmati system are the worst sufferers. Concrete damage estimation of life and property is not feasible from any yardstick due to dearth of accurate data and mechanism. The Bihar Irrigation Commission, 1992 has, however, tried to

do the needful and its report can be perused m the context of the study area. According to it, damage caused by floods are classified broadly into the following two categories

(a) Direct damages.

(b) Indirect damages

Direct Damages

These are the following aspects of direct damages

(a) Growing and pre harvest crops;

(b) Houses and household assets;

(c) Public utility work;

(d) Public buildings;

(e) Losses of human lives and livestock.

Indirect Damage

The indirect losses are not susceptible to quantification. Therefore, approximate monetary evaluation can only be done for such damages. These generally include:-

(a) Loss of earning in agro-based industries and trade;
(b) Loss of revenue to the road and rail transport system due to disruption or services
(c) Loss of revenue to small shop-keepers and other daily wage earners; and
(d) Loss of employment to the daily wage earners in public and private sectors.

Work of Data Collection

Flood damage data in Bihar are collected by the Revenue Department and they are responsible for co-'ordination and publication of flood damage statistics district wise at the State Level. Collection of data at Village River is taken care of by V.L.W. which mainly relates to the total area and the cropped area affected by floods and the extent of crop damage. The damage figures reported by V.L.W. are supposed to be checked by supervisory staff. But it appears that more often, this is not done by them. To get relief for damages to house and B.D.O. of the respective C.D.B. have been entrusted to check the claims of victims. But practically no such check work is done.

The various Committees appointed from time to time in the past have either directly or indirectly referred to the unsatisfactory state of flood damage statistics and emphasised the importance of scientific assessment. They made several suggestions for improving the system of collection of data, processing and reporting. The Central Flood Control Board had decided that the Flood Control (F.C.B.) Departments of the states should compile basin wise flood damage data with effect from 1960. But this is not being done in Bihar and the flood damage data still continues to be collected district wise by (Relief & Rehabilitation) Revenue Department.

Flood Damage Assessment

In the line of RBI. The Flood Commission of Bihar recommends that the recommendations of the RBI should be followed strictly and realistic evaluation of flood damage river basin / sub-brain wise be carried out every year under the following three separately identified categories:-

(a) Unprotected areas

(b) Protected areas due to failure of protection works, and

(c) Area situated between the embankments and the river.

The flood commission has done this work to some extent. While doing basin wise analysis of total damage data and total area affected due to flood. Five years of moving average have been taken help of for identifying the trend underlying the available annual series of data for period 1968 to 1992. The table presented below has been prepared with the help of the basin wise average damage report of FCB of Bihar.

The damage calculation of the district can be done with the help of table 1 and ratio of damage should be computed on the basis of flood-affected area of the study area.

Flood Forecasting

Though flood control measures are being carried out for reducing the losses caused by floods, it is not possible to provide protection at all places and against all magnitudes of floods. Moreover, flood control measures involve considerable time and energy. Flood damage can be avoided to a considerable extent if timely warning can be given of impending floods. It is rightly said "Forewarned is for armed". Flood forecasting services give advance warning to the engineering authorities for keeping desmids vigil and safeguarding various structures. With a good working system, floods can be considerably moderated and water can be conserved for irrigation as well as other domestic works. Regulators in canal systems can be operated in time, if a flood warning is received sufficiently in advance.

The flood forecasting and warning system was first started in India in 1959 on the Yamuna for the benefit of the union territory of Delhi. Subsequently flood forecasting centres have been established for forecasting of floods in many river basins. The region under study has two flood forecasting centres.

The system of flood forecasting consists of four phases:

(i) Observation and allocation of the operational data. This is done by the Central Water Commission and Indian Meteorological Department;
(ii) Transmission of data by these bodies to the flood forecasting centres;
(iii) Formulation of forecasts on the basis of rainfall in the catchment areas; and
(iv) Issue of forecasts; on an average, 4000 forecasts at various places are issued during the monsoon season every year.

Task Ahead

In spite of the fact that a number of flood control measures, both long term and short term methods have been applied in five year plan. But most of the measures have failed due to inadequacy of financial resources at due time. While the average annual loss on account of flood is going up year after year and affecting about 40% people of the region under study. Contrary to it, expenditure on flood control in the region in relation to the state as a whole has been hovering between 15% to 25% since 3rd plan. Hence, damages due to Hoods have kept mounting up.

To mitigate the wooes of the flood affected areas the Master Plan for Flood Control was envisaged long back in December, 1976. Many proposals, mentioned below, were advanced. These are as such:

(i) New embankments in the rest left part of the river Burhi Gandak and its tributaries;
(ii) Raising and strengthening the existing embankments;
(iii) Improvement in natural drainages,
(iv) River training works
(v) Protection of the important towns
(vi) River diversion works;
(vii) Flood Detention reservoirs;
(viii) Soil conservation measures;

Some of the above mentioned proposals have been undertaken in due course of time. But the real success lies in the Nepalese territory. Therefore, concrete talk and follow-up action must take place between our Government and the Majesty of Nepal Government. Basic and inter-basin wise comprehensive plan should be adopted for proper

management of water resources. Setting up of an International Commission of India and Nepal for flood control and soil conservation for rivers emanating from Nepal. The works once adopted by GADA must be completed forth with.

Conclusion

As it is clear that problem of floods can't be tackled locally within the frontier of the State of Bihar or with meagre resources available to a state like Bihar in particular. Hence, tackling of flood problem has to be conceived as an overall management of water resources. In this context, flood problem must be accepted as the national responsibility. It has become even more important because of the fact that the truncated Bihar has only water and soils.

Further it can be said that there is an emergent need for an integrated approach to the problem of flood control, irrigated agriculture, import of improved technology with better management of soil, evolution of the right type of cropping pattern etc. Adequate stress on research extension and training has to be given.

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