

## **Minutes of the 9<sup>th</sup> meeting of Task Force for Interlinking of Rivers held on 30<sup>th</sup> May, 2018 at New Delhi**

The Ninth Meeting of Task Force for Interlinking of Rivers was held on 30<sup>th</sup> May, 2018 at New Delhi under the chairmanship of Shri B. N. Navalawala, Chairman, Task Force & Chief Advisor, Ministry of Water Resources, River Development and Ganga Rejuvenation. List of the participants is at Annex-I.

At the outset, Chairman, Task Force for Interlinking of Rivers extended a warm welcome to all the Members, Special Invitees and other participants attending the meeting. He requested Director General, NWDA to take up the Agenda items.

The Chairman, Task Force mentioned that since the representatives of Kerala and Tamil Nadu are invited in the meeting for participating in the discussions on Surplus water in River basin for Interlinking of rivers, therefore, he requested Director General, NWDA to take up first Agenda Item No. 9.3, viz Surplus water in River basin for Interlinking of rivers.

### **Item 9.3: Surplus water in River basin for Interlinking of rivers**

The Director General, National Water Development Agency informed that during 14<sup>th</sup> meeting of Special Committee on Interlinking of Rivers (SC-ILR) held on 17<sup>th</sup> January, 2018, while discussing the guidelines for working out the surplus water in a river basin, Hon'ble Union Minister (WR, RD&GR) and Chairman of SCILR advised NWDA to invite the Kerala and Tamil Nadu States in the next meeting of Task Force on the ILR and consider their views and revise the guidelines, if required.

The DG, NWDA informed that while finalising these guidelines NWDA has obtained the views of all the members of TAC of NWDA including the Kerala and Tamil Nadu States. The TAC of NWDA and TF-ILR have considered these comments appropriately and finalised the guidelines. However, the views of these two states & response on these observations have already sent to Kerala and Tamil Nadu States before this meeting. He again explained above observations and response of NWDA. After detailed discussions the representatives of both the States were satisfied with the response of NWDA/TF-ILR and it was decided that no change is required in the guidelines finalised by TF-ILR in the earlier meeting and circulated with the agenda of this meeting (Annex – II).

Further, the representative of Kerala raised the issue of considering the ground water while working out the water balance in a river basin. The issue was deliberated in detail but no conclusion could be reached on this issue. The Chairman, Task Force decided to discuss the issue of inclusion of Ground Water in the water balance studies and decided to convene a meeting at Gandhinagar with Chairman, Central Water Commission, Director General, National Water Development Agency and Chairman, Central Ground Water Board.

**Item 9.1: Confirmation of the minutes of the 8<sup>th</sup> meeting of the Task Force for Interlinking of Rivers held on 15<sup>th</sup> September, 2017 at New Delhi**

Director General, NWDA informed that the minutes of the eighth meeting of the Task Force for Interlinking of Rivers (TF-ILR) held on 15.09.2017 at New Delhi were circulated to all the members vide letter dated 26.10.2017. Since, no comments were received from any of the members, the Minutes of the eighth meeting of the Task Force for Inter Linking of Rivers were confirmed as circulated.

**Item No.9.2 Constitution of the Financial Sub Committee/ Group:**

Director General, NWDA informed that in pursuance to the decision taken by the Task Force for Interlinking of Rivers in its 6<sup>th</sup> meeting held on 13<sup>th</sup> February, 2017, Ministry of Water Resources, RD & GR vide letter dated 12.09.2017 constituted a “Group on Financial Aspects under Task Force for Interlinking of Rivers” headed by Dr. Prodipto Ghosh, Former Secretary to the Govt. of India and Member of the Task Force. Nine meetings of this group have been held and last meeting was held on 1<sup>st</sup> May, 2018. During these meetings, the Group discussed the modalities as how to proceed, the procedure/method to work out the cost of total ILR programme and various options of funding. The Group has worked out Rs. 8.68 lakh crore as the total cost of ILR projects.

Dr. Ghosh, Chairman of the Group on Financial Aspects and a member of the Task Force made a presentation on the various aspects of funding options for Interlinking of Rivers programme and the progress of work and approach of the Group in addressing the ToRs of the Group. The Chairman of the Task Force for ILR appreciated the approach of the Group and also the work done by the Group. He advised that the first attempt be made to suggest funding options for implementation of four priority links viz. Ken-Betwa, Par-Tapi-Narmada, Damanganga-Pinjal and Godavari-Cauvery Link Projects. The Chairman, Task Force suggested Dr. Ghosh to involve Dr. E.A.S. Sarma, Retd. Finance Secretary of Govt. of India as special invitee in the deliberations of the Group.

It was also informed that Ministry of WR, RD & GR vide letter dated 24.04.2018 extended the tenure of the Group on Financial Aspects for a further period of four months beyond 25.02.2018. The Chairman, Task Force agreed for further extension of tenure of the Group upto end of July 2018 and requested Dr. Ghosh to submit the Group’s report by the end of July, 2018. The Chairman, Task Force suggested that the report shall consist possible funding options. After the inter-State/international agreements are signed with the concerned States/Nations, based on this interim report, the financial institutions (national / international) can be approached for discussion to work out the detailing and forms of funding of the project.

**Item 9.4: Alternative proposal of Diversion of Godavari waters upto Cauvery basin**

Director General apprised the members of the Task Force regarding Godavari-Cauvery Link Project. He mentioned that NWDA has taken up the preparation of Detailed Project Report (DPR) of the Godavari-Cauvery Link Project on the direction of the Hon'ble Minister (WR, RD & GR).

**Item 9.5: Any other Item with the permission of the Chair**

- 1- The Chairman, Task Force enquired that considering the increased activities related to Inter Linking of Rivers including preparation of DPRs of many link projects, whether the present manpower is sufficient to complete these activities/works. The Director General, NWDA indicated that the NWDA is facing acute shortage of manpower (both technical and non-technical) and most of the officers will be retiring by the year 2021. He further, informed that the Sub-Committee for restructuring of NWDA has already submitted its report to the MoWR, RD & GR in the year 2015. This report was processed by the Ministry and it has been informed that the Ministry is undertaking larger reforms and restructuring of NWDA will become the subset of this reform. The Chairman, Task Force assured that he will take up this issue with the Hon'ble Minister (WR, RD & GR).
  
- 2- Shri SriramVedire, Member of the Task Force, ILR mentioned that Govt. of Rajasthan prepared a proposal of Eastern Rajasthan Canal, DPR of which is presently under appraisal in Central Water Commission. He requested that this proposal may be considered as an ILR proposal as an alternative to Parbati-Kalisindh-Chambal link project of National Perspective Plan. The Chairman, Task Force, ILR suggested that Central Water Commission should first complete the appraisal of Eastern Rajasthan Canal Project and thereafter Task Force will consider this project.

Meeting ended with a vote of thanks to the Chair.

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**Annex-I****List of Members, Special Invitees and participants of the Ninth Meeting of the Task Force for Interlinking of Rivers held on 30.05.2018 at New Delhi.**

1.	B.N. Navalawala, Chief Advisor, MoWR, RD & GR Chairman, Task Force for ILR	Chairman
2.	Shri Prodipto Ghosh, Former Secretary, MoE&F& Distinguished Fellow, TERI, New Delhi	Member
3.	Shri S. Masood Husain Chairman, CWC, New Delhi	Member
4.	Shri A.D. Mohile, Former Chairman, CWC, New Delhi	Member
5.	Shri SriramVedire, Advisor, Ministry of WR, RD & GR, New Delhi	Member
6.	Shri M. K. Srinivas, Director General, NWDA, New Delhi	Member-Secretary
	<b>State Government's Officers :</b>	
7.	Shri K. A. Joshy, Chief Engineer, (ISW), WRD Govt. of Kerala, Thiruvananthapuram	Representing Govt. of Kerala
8.	Shri K. S. Ramkumar, Vice-Chairman, Cauvery Technical Cell- cum-Inter State Waters Wing, Govt. of Tamil Nadu, Chennai	Representing Govt. of Tamil Nadu
9.	Shri Thomas Mathew, Joint Director, IDRB, Irrigation Dept. Govt. of Kerala, Thiruvananthapuram	
10.	Shri Vijay Kumar P. G, Nodal Officer, Govt. of Kerala, New Delhi	
	<b>NWDA Officers :</b>	
11.	Shri R.K. Jain, Chief Engineer (HQ), New Delhi	
12.	Shri K.P. Gupta, Director (Tech.), New Delhi	
13.	Shri Muzaffar Ahmad, Superintending Engineer, New Delhi	
14.	Shri Anil Kumar Jain, Deputy Director, New Delhi	
15.	Shri Nizam Ali, Consultant, New Delhi	

## **Guidelines for working out Water Balance in a river basin finalized by the Task Force for ILR after deliberation in its 9<sup>th</sup> meeting**

### **Chapter 2**

#### **Basin and Sub-basin**

- 1 If the variation in catchment area of any basin/ sub-basin between NWDA and State Governments figures is within 5% there is no need to revise the figures.

### **Chapter 3**

#### **I Soils, Land Use, Delta and Water use**

- 1 The present practice of obtaining land use data of the basins from the land use statistics collected by the Directorate of Economics and Agriculture Statistics of various States may be continued by the NWDA.
- 2 It was agreed that in case of such future projects for which project reports have already been approved by CWC, the cropping pattern as given therein should be considered and for other future projects cropping pattern will be based on the availability of water and agro-climate zone.
- 3 Fodder crops should be included in the cropping patterns recommended by the NWDA in the water balance studies.
- 4 The culturable command area (CCA) need not be projected to 2025 AD/2050 AD and it would be adequate to consider the maximum culturable area of recent five years.
- 5 The permanent pastures and other grazing land need not be included in the culturable area of the basins / sub-basins and no separate provision would be necessary for irrigating the permanent pastures and other grazing lands.

### **Chapter 5**

#### **Water Availability**

#### **Computation of Yield**

- 1 The yield studies carried by using the rainfall-runoff correlations taking monsoon months as a whole would be continued.

- 2 In case where there is no G&D site or the existing G&D sites cover only a small portion of the catchments, rainfall-runoff relationship obtained for the adjoining hydro-meteorologically similar basin/ sub-basin may be adopted.
- 3 Regeneration from upstream utilisation of both in-basin and imported waters should be considered in the assessment of virgin yields.
- 4 The surface water yield need not be worked out at the state boundaries. The existing procedure for deciding the best-fit equations on the basis of the minimum standard error of estimate might continue.
- 5 Hydrological studies may be updated after a period of 10 years when additional data will be available.
- 6 Though the computer programmes of all the alternative methods have been developed but for water balance studies linear/non-linear type of correlation could continue.
- 7 Import/Export: - While updating the water balance studies export/import of one sub-basin may be compared with the figures for corresponding basin/ sub- basins. Unallocated export/import may be reconciled. The hydrological checks as above may be made for the import/ export figures also.

### **Water Availability**

- 1 The water balance study may project water availability at both 75% and 50% dependability. However, the proposed schemes should provide for a 75% success rate.
- 2 The water balance study should consider the surface water resources only while estimating the water balance in a river basin/sub-basin
- 3 Water availability upto the project site to be worked out on the basis of the following:

In case, if sufficient flow data is available for 40 years or more for a basin/ sub basin, the yield may be further rationalised by using the area ratio and rainfall ratio as follows:

Yield at site = Yield of G&D site x (Catchment area of site x Avg. rainfall of site)/ (Catchment area of G&D site x Avg. rainfall of G&D site)

In case sufficient flow data is not available, extended flow series based on rainfall-runoff correlations at G&D site may be used for computing yield at Project site. Rainfall-runoff relationship for monsoon period as a whole

shall be developed by regression analysis both for linear and nonlinear form of equations.

In case no G&D site is available within the basin/sub basin, extended flow series based on rainfall-runoff correlations for the G&D site adjacent to the basin/sub basin with similar hydrological conditions may be used for computing yield at Project site. Rainfall-runoff relationship for monsoon period as a whole shall be developed by regression analysis both for linear and nonlinear form of equations.

- 50% and 75% yield computed as above may further be adjusted for the ultimate utilizations upstream, exports and imports to compute 50% and 75% dependable availability.
- Water utilizations for any project should be restricted to a maximum of 75% dependable availability in case of diversions. However, for storage projects requirement may exceed 75% dependable availability with provisions of carryover storage.
- Suitability of dam site: This aspect may be accepted as per the information provided by the State Governments/Master Plan.

## **Ground Water**

- 1 The NWDA studies may consider surface water resource only while estimating water balance. The groundwater potential may not be considered as an available resource for the water balance studies being done by NWDA. However, conjunctive use of surface and ground water can be planned while preparing DPR of Water Resources Projects.
- 2 The NWDA studies may consider the gross groundwater potential of the basin/ sub-basin assessed from the statistics supplied by the CGWB/State Groundwater Boards (SGWB).

## **Chapter 6**

### **Water Requirements**

#### **Domestic and industrial water requirement**

- 1 The 50% of the rural water requirement and entire livestock water requirement is proposed to be met from groundwater sources. The urban water requirement in full and 50% of the rural water requirement is to be met from surface water sources.
- 2 Entire industrial water requirement is to be met from surface water sources.

- 3 The per capita water requirements @ 135 lts. and 70 lts. for urban and rural population may be adopted in the NWDA studies with 80% of the water returning back to the system.
- 4 In order to update the water balance studies it was decided that while revising the studies population projections may be made upto 2050 AD as per latest revision of UN publication "world population prospectus" on medium variant growth rate.

### **Salinity Control**

- 1 A lump sum provision of 10% of the 75% dependable yield will be earmarked for salinity control tentatively pending detailed studies in this area.

### **Water releases in the river for environment and ecology**

- 1 Regarding how much quantity of water to be released in the river for environment and ecology, it was decided that this issue may be finalized through an expert committee or by the Ministry of Environment and Forests.
- 2 After meeting downstream requirements a minimum lean season flow of 10% of the inflow at diversion structures should be maintained for environmental and ecological purposes with storages. This could be of the order of 10% of the average lean season natural flow downstream of the storage.

### **Annual Irrigation**

- 1 The intensity of irrigation in the case of existing and ongoing projects will be as per the present use. Under Peninsular river development component for the future projects, the intensity may be based on recommended cropping pattern considering the agro-climatic zone and available water at 75% dependable flow. However maximum intensity of irrigation may be restricted to 150% for major projects, 125% for medium projects and 100% for minor projects. The studies should also consider possibility of augmentation in the existing storages to increase the present intensity of irrigation, wherever this is less than the percentages indicated above for the future projects.
- 2 Any surplus surface water for transfer should be assessed only after considering the water needs of the basin for extending irrigation to atleast 60% of net culturable area.



### **Area to be Brought under Irrigation by 2050 AD**

1. In case of deficit basins/sub-basins, where the percentage of existing irrigation from surface water is around 30% of the culturable area, the NWDA may consider extending irrigation facilities to 60% of the culturable area and the additional area to be brought under irrigation would be for a single dry crop without considering any high water consuming crop like sugarcane and paddy.
2. The command area of each proposed project may be examined with regard to availability of culturable area overlap with other projects etc. at the time of updating the water balance studies.

### **Irrigation Water Requirement**

1. The water requirement for irrigation should be worked out on climatological approach and reasonable provisions made for the field and transmission losses as well as evaporation from the storages.
2. In case of future studies irrigation efficiencies of 65% for major and medium projects with a regeneration value of 20% and irrigation efficiency of 80% for minor projects without considering any regeneration shall be considered while working out GIR.
3. The evaporation losses may be based on the available data for the existing major and medium reservoirs in and around the basin. Any figure for evaporation losses which is accepted in Tribunal Awards or agreements between the states may be taken for the NWDA studies for the concerned basin/ sub-basin.
4. The reservoir evaporation losses may be worked out based on the pan-evaporation data available in the vicinity. However, in the absence of actual data, 20% of the withdrawals from the reservoir may be considered as evaporation losses.
5. While presenting the requirements of projects located within sub-basins and basins, the allocations indicated by the awards/agreements will be retained in the studies without any change.

### **Regeneration**

1. In the case of Krishna, Godavari and other basins, where Tribunal Awards are available, the estimated regeneration to the stream for irrigation, domestic, industrial and other uses for the NWDA studies might be as specified in the Award. In the case of other basins/sub-basins, the estimated regeneration in the NWDA studies might be at the rate of 20% of the

irrigation use from major and medium irrigation projects, no regeneration from minor irrigation projects and 80% from both of the domestic and industrial uses from surface water resources. No regeneration would be assumed for domestic and industrial uses from groundwater resources. The percentage of regeneration may undergo change based on the scientific studies to be carried out in this regard.

### **Special Technical Points related to Himalayan Component Studies**

#### **1 Intensity of irrigation**

Considering availability of considerable groundwater potential in the basins of the Himalayan rivers, it was decided that the areas where existing irrigation intensity is less than 100%, the same maybe increased to level of 100% from surface water. Wherever, the existing intensity of irrigation is more than 100% the intensity can remain at the same level. Additional intensifications over and above those indicated above may be carried out by using groundwater to encourage conjunctive use and to avoid the problems of water logging and salinity.

#### **2 Irrigation in the enroute areas**

The areas enroute of the link canals not covered by any other irrigation scheme may be provided with irrigation to the extent of 100% intensity from the surface water and any additional irrigation by groundwater.

#### **3 Irrigation in the target areas**

The target area should be covered by extensive irrigation and an intensity of not more than 100% should be provided from the transferred water.

#### **4 Water requirements downstream of diversion points**

While carrying out water balance studies at the point, where diversions are contemplated, the water requirements will also include the committed utilizations and additional requirements of downstream areas, which cannot be met from the water available downstream.

#### **5 Seasonal water balance**

Water balance study at diversion points where reservoir is contemplated will be carried out on annual basis as most of the flows can be considered to be regulated. However, at diversion point where reservoirs are not contemplated, water balance study will be carried out on a seasonal basis.

## **Allowable Lifting of Water for Inter Basin Water Transfer Links**

Present maximum allowable limit of lift 120m may be enhanced beyond 120m but subject to techno-economic viability of the project and ensuring that the economic cost of pumping / electricity charges has to be taken into account and not the subsidized cost of pumping / electricity charges)

## **Guidelines regarding the extent of Surveys and Investigations Necessary for Preparation of Feasibility Report**

### **1 Inter-State links**

The guidelines as prepared by NWDA regarding the extent of Surveys and Investigations necessary for preparation of Feasibility Report accepted by the TAC.

### **2 Intra-State link proposals**

Regarding technical guidelines for preparation of PFR/FR of Intra-State links, Director General, NWDA proposed to follow same technical guidelines as adopted for surveys and investigations for preparation of feasibility report of Inter basin water transfer proposal prepared and got approved from TAC in 1996. TAC agreed to use these guide lines for preparation of Feasibility Report of Intra State link proposals also.

**Guidelines for Preparation of  
Preliminary Water Balance Reports  
(As finalised by Task Force for ILR  
In its 9<sup>th</sup> meeting)**

**NATIONAL WATER DEVELOPMENT AGENCY  
GUIDELINES FOR THE PREPARATION OF PRELIMINARY WATER  
BALANCE REPORT**

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# Chapter 1

## INTROUDCTION

### 1.1 General

The overall water situation of the country shall be indicated briefly. The national perspectives for water resources development including Himalayan and / or Peninsular component shall be briefly discussed in this Para. Also brief background about creation of NWDA and scope of studies shall be indicated.

### 1.2 The report

Total number of reports to be studied under relevant components shall be indicated in this para. The name of sub-basin to be studied shall be indicated in this para.

### 1.3 Methodology adopted for working out water balance.

The procedure / methodology adopted for working out water balance covering type of soil, estimation of yield, ground water potential, water requirement, regeneration etc., shall be briefly described in this para with sub paras as required.

# Chapter 2

## **BASIN AND SUB-BASIN**

### **2.1 Basin**

Brief description of the basin shall be indicated in this para. This shall include total catchment area, total length of river, percentage of area lying in various states, latitude and longitude of basin and its important tributaries.

### **2.2 Sub-basin**

Brief description of the sub-basin indicating place of origin of river / tributary, its course, length, latitude and longitude of sub-basin, important tributaries and state-wise break up of catchment area shall be given in this para.

Table giving name of states and districts falling in the catchment area of districts and their percentage to the total geographical area of the sub-basin shall be furnished.

If the variation in catchment area of any basin/ sub-basin between NWDA and State Government figures is within 5% there is no need to revise the figures. The area considered by NWDA shall be taken as final.

Index map showing river basins in India and also Index map of the basin / sub-basin showing river and tributaries, important towns, railway lines, national highways etc as Plate 1 and administrative map showing States/districts/talukas and their headquarters as Plate 2 shall be appended to the report.

### **2.3 Topography, Physiography, Geology and Hydrogeology**

#### **2.3.1 Topography and Physiography**

The main topographical and physiographical features of the basin/sub-basin shall be briefly described here.

#### **2.3.2 Geology**

Different geological formations occurring in the basin / sub-basin shall be indicated here.

#### **2.3.3 Hydrogeology**

Based on the information collected from Central Ground Water Board, the hydro-geological formations of the basin/sub-basin including groundwater availability shall be briefly described. Details of water bearing formation etc. shall be indicated in Plate-3.



## **2.4 Climate**

Various seasons and their period shall be indicated. General description of climate of each season of the year shall be indicated.

### **2.4.1 Rainfall**

Number of rain gauge stations located in the basin along with the period of availability of rainfall data, maximum, minimum and normal rainfall etc., shall be described in this Para supported with Annexures. In annexure, sources of data viz. from IMD, State Governments shall be indicated.

### **2.4.2 Temperature**

Monthly and annual ranges of variation of temperature of the basin / sub-basin as observed in IMD observatories in and nearest to the basin / sub-basin shall be indicated supported with Annexures.

### **2.4.3 Relative humidity**

Variation of mean relative humidity, month wise as observed in IMD observatories in or around the basin / sub-basin shall be indicated in this para supported by annexure.

### **2.4.4 Wind speed**

Data on wind speed in the basin / sub-basin as observed in IMD observatories in or around the basin / sub-basin shall be indicated month-wise in annexure.

### **2.4.5 Sunshine**

The maximum and minimum range of monthly sunshine hours in percent as observed at IMD observatories in or nearest to the basin / sub-basin shall be indicated in this Para supported with suitable Annexures.

## **Chapter 3**

### **SOILS AND LAND USE**

#### **3.1 Soils**

General information regarding data/soil surveys based on which information is furnished shall be indicated including limitations. The type of soils lying in the basin/sub-basin shall be indicated.

Properties of each type of soil, namely colour, depth, chemical characteristics, PH value, texture, structure, drainages etc. shall be briefly described in sub-paras.

A map showing different type of soils in the basin/sub-basin shall be appended as plate 4.

#### **3.2 Land irrigability classification**

Brief description of land irrigability classification based on physio-chemical characteristics of soil or as obtained from detailed soil survey data shall be discussed in brief in this Para. Area under each class shall also be presented in tabular form, if such information is available.

#### **3.3 Land use**

Annual land use particulars of the basin/sub-basin shall be collected for the latest five years available from Bureau of Economics and Statistics of respective State Governments and shall be presented state-wise in the form of suitable annexure. Culturable area which comprises of land under miscellaneous crop and trees, current fallows, other fallows, culturable waste and net area sown for the five years under compilation shall be presented in a tabular form. The details of land use particulars for the year in which culturable area is found to be maximum shall be reproduced in tabular form and shall be used in the study.

#### **3.4 Land holdings**

Details of land holding in the basin/sub-basin be compiled from district wise figures and presented in tabular form showing number of holdings for different size groups, their area and percentage of total area.

#### **3.5 Cropping pattern**

Details of areas under various crops in the basin/sub-basin shall be collected from State Bureau of Economics and Statistics for both irrigated and un-irrigated area and presented in the form of suitable annexure. Also, designed

cropping patterns of some of the important existing, ongoing and future major and medium projects shall be collected and presented in the form of Annexure. The prevalent cropping pattern in the basin/sub-basin shall be briefly described and suggested cropping pattern based on same for proposed major, medium and minor projects with 150%, 125% and 100% intensities of irrigation respectively shall be presented in a tabular form. The intensity of irrigation for proposed projects shall be taken as proposed by States Govt. and shall be restricted to above value.

In case of such future projects for which project reports have already been approved by CWC, the cropping pattern as given therein should be considered and for other future projects cropping pattern will be based on the availability of water and agro-climate zone.

Fodder crops should be included in the cropping patterns recommended by the NWDA in the water balance studies.

# Chapter 4

## REGIONAL ECONOMY

### 4.1 Population

The total population, rural and urban population of the basin/sub-basin based on the latest census data shall be reported. The average density of the population in the basin/sub-basin shall be indicated.

### 4.2 Forest

The area covered by the forest and percentage to geographical area shall be indicated. Type of forest shall be briefly mentioned along with names of important species.

### 4.3 Agriculture and animal husbandry

The net area sown and its percentage to the geographical area of basin/sub-basin, crops grown etc., shall be indicated. Types of implements used in agriculture and live stock population as per latest census may be indicated.

### 4.4 Irrigation

The gross area irrigated from canals, tanks and wells and its percentage to gross cropped area shall be indicated. The source wise irrigation for the latest 5 years shall be appended as an annexure. Source of data shall be indicated in the annexure.

### 4.5 Power

The existing, ongoing and proposed Thermal, Hydel and Atomic power stations, if any, in the basin/sub-basin shall be reported.

### 4.6 Mineral wealth

Important minerals found in the sub-basin shall be mentioned.

### 4.7 Industries

Various types of industries including cottage and small scale existing in the sub-basin shall be mentioned.

### 4.8 Communication

National highways, railway lines connecting, important places in the basin/sub-basin, airport and seaport shall be mentioned.

# Chapter 5

## Water Availability

### 5.1 General

Purpose of the chapter shall be indicated in this para.

### 5.2 Surface water resources assessment

#### 5.2.1 Past studies conducted by other agencies

Past studies conducted by other agencies for assessment of surface water resources shall be briefly described in this para indicating their assessment at various dependabilities.

#### 5.2.2 Availability of rainfall data

The availability of rainfall data of various rain-gauge stations in and around the basin/sub-basin which are considered for working out weighted average rainfall of the basin/sub-basin shall be indicated. Missing data of the rain gauge station, if any, shall be estimated using standard statistical methods.

Weighted average monsoon rainfall of the entire basin/sub-basin for the long term period (at least 35 years) for which data is available and also of the basin/sub-basin upto the selected G&D site for the period of availability of runoff data shall be computed by Thiessen polygon method. Details of computation are to be presented in the form of suitable annexure.

#### 5.2.3 Availability of observed discharge data

Gauge and Discharge sites maintained by different Agencies/States and Central Water Commission shall be indicated. The period of availability of data and drainage area covered in respect of each site shall also be shown in a table. The consistency of observed discharge data shall be checked thoroughly. If observed discharge data for particular years is found to be inconsistent, it should be rejected and reasons thereof shall be explicitly indicated.

#### 5.2.4 Upstream utilisation

Details of year-wise existing utilisation in the basin/sub-basin upstream of the G&D site shall be collected from State Govt. Sources and presented in the form of suitable annexures. In the absence of data, appropriate values of delta may be assumed for estimating utilisation.

Storage effect on account of both Irrigation and Hydel projects be considered to arrive at virgin yield.

While working out virgin yield, regeneration at the rate of 20% of net utilisation from existing major, medium projects and also from imported water upstream of G&D site shall be considered. Virgin monsoon yield upto the selected G&D site shall then be worked out adding upstream utilisation from existing major, medium and minor projects (excluding utilisation from imports) to the observed monsoon yield and deducting regeneration. Details of computation shall be presented suitably in an annexure.

### 5.2.5 Computation of yield:

1. The water balance study may project water availability at both 75% and 50% dependability. However, the proposed schemes should provide for a 75% success rate.
2. The water balance study should consider the surface water resources only while estimating the water balance in a river basin/sub-basin
3. Water availability upto the project site may be worked on the basis of the following:
  - I. In case, if sufficient flow data is available for 40 years or more for a basin/sub basin, the yield may be further rationalised by using the area ratio and rainfall ratio as follows:

Yield at site = Yield of G&D site x (Catchment area of site x Avg. rainfall of site) / (Catchment area of G&D site x Avg. rainfall of G&D site)

- II. In case sufficient flow data is not available, extended flow series based on rainfall-runoff correlations at G&D site may be used for computing yield at Project site. Rainfall-runoff relationship for monsoon period as a whole shall be developed by regression analysis both for linear and nonlinear form of equations. The form of equations to be used shall be as follow:

(i)  $Y = a+bx$

(ii)  $Y = ax^b$

Details of computation shall be presented in annexure including graphical plot of rainfall Vs runoff. Best fit regression equation shall be selected on the basis of least standard error of estimate and co-efficient of correlation not below 0.70.

- III. In case no G&D site is available within the basin/sub basin, extended flow series based on rainfall-runoff correlations for the G&D site adjacent to the basin/sub basin with similar hydrological conditions may be used for computing yield at Project site. Rainfall-runoff relationship for monsoon period as a whole shall be developed by regression analysis both for linear and nonlinear form of equations.

Details of computation shall be presented in annexure including graphical plot of rainfall Vs runoff. Best fit regression equation shall be selected on the basis of least standard error of estimate and co-efficient of correlation not below 0.70.

Weighted average monsoon rainfall of each year shall be substituted in the selected regression equation to develop long term monsoon yield series of the basin/sub- basin. The monsoon yield shall be worked out as a percentage of net non-monsoon yield to virgin monsoon yield from the observed set of run-off data and corresponding utilization. The computation shall also be presented in the form of annexure. The annual yield series shall be arrived at by adding both the monsoon yield and the non-monsoon yield. The yield shall be arranged in descending order in the same annexure and annual yield at 75% and 50% dependabilities shall be computed there from. The location of G&D sites and the hydro-meteorological stations, annual normal isohyets shall be shown in Plate 5.

When the catchment of a basins/sub- basin is sub divided for estimation of dependable yields, using observed flow data of more than one G&D site, the long term annual yields series for each part catchment shall be estimated as indicated above. The annual yields of each year of such part catchments shall be added to arrive at annual yield series for the whole basin/sub- basin. Thereafter dependable yields of whole catchment shall be estimated using procedure stated above.

4. Flow series based on observed data rainfall-runoff regression should be corrected for existing utilization in order to work out virgin yield.

The surface water yield need not be worked out at the state boundaries.

Hydrological studies may be updated after a period of 10 years when additional data will be available.

### **5.3. Import/Export**

Details of import from existing, ongoing and future identified projects located outside the basin/sub-basin shall be collected from State Govt. sources and briefly described here. Similarly, details of export, outside basin/sub-basin from existing, ongoing and proposed projects located within the basin/sub-basin shall also be collected from State Govt. and briefly described. The details of import and export shall be presented in the form of suitable annexure giving details of annual irrigation and annual utilisation in respect of each of the project.

### **5.4. Ground water assessment**

#### **5.4.1. Ground water availability based on CGWB estimates**

Ground water potential and existing draft of the basin/sub-basin shall be computed on proportionate area basis from the latest data collected from Central Ground Water Board, in absence of which from statistics of State Ground Water

Boards and presented in an annexure. Ground water may be indicated as a separate resource State wise.

### **5.5 Allocation of water as per Tribunal Award**

In case any Tribunal Award is existing for any basin/sub-basin, the same shall be briefly described and allocation to each State presented in tabular form giving reference to Tribunal Award, page number etc. in respect of the particular project.

### **5.6 Availability of Surface Water**

The water balance study should consider the surface water resources only while estimating the water balance in a river basin/sub-basin

50% and 75% yield computed as above may further be adjusted for the ultimate utilizations upstream, exports and imports to compute 50% and 75% dependable availability.

Water utilizations for any project should be restricted to a maximum of 75% dependable availability in case of diversions. However, for storage projects requirement may exceed 75% dependable availability with provisions of carryover storage.

Suitability of dam site: This aspect may be accepted as per the information provided by the State Governments/Master Plan.

### **5.7 Seasonal water balance**

For Himalayan Component the aspect of Seasonal water balance may be followed as given below:

Water balance study at diversion points where reservoir is contemplated will be carried out on annual basis as most of the flows can be considered to be regulated. However, at diversion point where reservoirs are not contemplated, water balance study will be carried out on a seasonal basis.



## Chapter-6

### Water Needs

#### 6.1. General:

The various needs that are to be met while planning for water resources development is to be indicated here.

#### 6.2. Domestic water requirement:

It is expected that population of India will hopefully stabilise by 2050 AD. Hence domestic water requirements shall be worked for this ultimate situation. Domestic water requirement for urban, rural and livestock population of the basin/sub-basin shall be worked state-wise.

The total and rural population of the basin/sub-basin shall be assessed on proportionate area basis from the latest available district-wise census data using the following formula and as per latest revision of UN publication "world population prospectus" on medium variant growth rate:

$$P_{2050} = P_{1911} (1+r)^n \quad \text{where}$$

r = annual compound rate of growth

n = nos. of year

Details of computation shall be presented in the form of Annexure.

The livestock population of the basin/sub-basin shall also be assessed on proportionate area basis from district-wise census data published by Bureau of Economics and Statistics of respective State Govt. and shall be projected to 2050 AD on the basis of same formula as above, but considering an annual compound growth rate of 1%. Details shall also be furnished in the form of Annexure.

Domestic needs shall be estimated considering per capita daily water requirement for urban and rural population as *135 litres and 70 litres* respectively as prescribed by the erstwhile Ministry of Works and Housing, Government of India in their manual "Water supply and Treatment". For livestock population, 50 litres per capita requirement shall be taken in the absence of standard norms. The ultimate domestic needs shall be worked out State-wise and presented in tabular form. The full requirement of urban population and 50% of rural population shall be considered to be met from surface water sources and the requirement of remaining 50% of rural population and entire livestock population shall be met from ground water.

Regeneration as return flow to the stream shall be worked out as 80% of surface water utilised for domestic purposes.

### **6.3. Surface water needs for irrigation:**

The data relating to existing, ongoing and proposed major, medium and minor irrigation projects shall be compiled from the master plans prepared by the State Governments including project reports and other relevant documents. The estimate based on this data will be the ultimate irrigation requirement in a basin/sub-basin.

#### **6.3.1. Irrigated area under existing projects:**

Details of existing major, medium and minor projects in the basin/sub-basins shall be collected from respective State Irrigation departments and indicated in this para. Also if any irrigation is presently being provided in the basin/sub-basin through any projects located outside the basin/sub-basin, the same is also to be indicated in this para. The annual irrigation from existing projects shall be considered as the designed annual irrigation from all projects including from import and shall be presented in the form of annexure giving details of G.C.A., C.C.A, actual and designed annual irrigation, intensity of irrigation and annual utilisation in respect of each project also indicating source of data therein.

#### **6.3.2. Annual irrigation from ongoing projects:**

Details of major, medium and minor projects under construction in the basin/sub-basin shall be collected from respective State Irrigation Departments and indicated in this para. Also if any irrigation is proposed to be extended in the basin/sub-basin, from any project under construction outside the basin/sub-basin, same shall also be indicated in this para. The annual irrigation from ongoing projects shall be considered as the designed annual irrigation as indicated in respective project reports/State Master Plan including same from import and shall be presented in the form of an annexure giving details of GCA, CCA designed annual irrigation, intensity of irrigation and annual utilisation in respect of each project also indicating source of data therein.

#### **6.3.3 Annual irrigation from identified future projects:**

Details of major, medium and minor projects identified for future implementation in the basin/sub-basin shall be collected from respective State irrigation Departments and indicated in this para. Also, if any irrigation to the basin/sub-basin is proposed from any identified future projects located outside the basin/sub-basin, same shall also be indicated in this para. The intensities of irrigation shall however be considered as 150%, 125% & and 100% in respect of major, medium and minor projects respectively and annual irrigation from identified future projects shall be worked out accordingly. An annexure indicating GCA, CCA annual irrigation intensity of irrigation, annual utilization etc. as per State Govt. and annual irrigation as proposed by NWDA in respect of each project shall also be presented indicating source of data therein.

In case of such basins/sub-basins, where annual irrigation from existing, ongoing and identified future projects is less than 60% of the culturable area of the basin/sub-basin, the balance of area shall also be considered to be provided with irrigation under future projects so as to bring the annual irrigation to cover atleast 60% of culturable area and additional area to brought under irrigation would be for a single dry crop without considering any high water consuming crop like sugarcane and paddy. 50% of such additional area shall be assessed to be covered by major and medium projects and balance by minor projects.

**For studies related to Himalayan Component Studies the following procedure may be followed:**

**(i) Intensity of irrigation**

Considering availability of considerable groundwater potential in the basins of the Himalayan rivers, it was decided that the areas where existing irrigation intensity is less than 100%, the same maybe increased to level of 100% from surface water. Wherever, the existing intensity of irrigation is more than 100% the intensity can remain at the same level. Additional intensifications over and above those indicated above may be carried out by using groundwater to encourage conjunctive use and to avoid the problems of water logging and salinity.

**(ii) Irrigation in the enroute areas**

The areas enroute of the link canals not covered by any other irrigation scheme may be provided with irrigation to the extent of 100% intensity from the surface water and any additional irrigation by groundwater.

**(iii) Irrigation in the target areas**

The target area should be covered by extensive irrigation and an intensity of not more than 100% should be provided from the transferred water.

**(iv) Water requirements downstream of diversion points**

While carrying out water balance studies at the point, where diversions are contemplated, the water requirements will also include the committed utilizations and additional requirements of downstream areas, which cannot be met from the water available downstream.

**6.3.4 Water use from the existing and ongoing projects:**

Designed annual utilization from the existing projects (major, medium and minor) in the basin/sub-basin shall be indicated in this para alongwith designed annual utilization from existing imports. The same shall also be included in the annexure prepared for irrigated area under existing projects.

Similarly designed annual irrigation from ongoing projects (major, medium and minor) in the basin/sub-basin shall be indicated in this para alongwith designed annual irrigation from ongoing imports. The same shall also be included in the annexure prepared for irrigated area under ongoing projects.

### **6.3.5 Water requirement of areas to be irrigated by identified future major, medium and minor projects:**

Water requirement for identified future projects shall be worked out using climatological approach. The cropping pattern to be considered is as suggested in Chapter-3. Crop water requirement in respect of crops proposed shall be computed considering monthly values of potential Evapo-transpiration (PE) of IMD observatory located in or nearest to the basin/sub-basin (average in case of more than one station being in the basin/sub-basin) as given in IMD Publication 'Potential Evapo-transpiration (PE) over India' (Scientific Report No.136, Feb. 1971). Monthly Evapo-transpiration and rainfall normal of the stations for the concurrent period shall be given in an annexure. Irrigation efficiency of 65% in case of major and medium projects and 80% in case of minor projects shall be considered. Details of computation shall be presented in the form of Annexure.

Average delta for each category of project shall be worked out considering actual evaporation losses (to be worked out based on the Evapo-transpiration data available in the vicinity), however in the absence of actual data on evaporation the same may be adopted as 20% of gross irrigation water requirement of crops and details of computation presented in the form of Annexure.

Water requirement for identified future projects shall then be worked out considering total annual irrigation under each category of projects multiplied by their respective average delta and presented in tabular form. The same shall also be included in the annexure for irrigated areas under identified future projects indicating annual utilization as proposed by State Govt. and also by NWDA therein respect of each project.

The ultimate water requirement as assessed for existing, ongoing and future projects in the basin/sub-basin shall also be presented in a tabular form.

Location of existing, ongoing and future major and medium projects in the basin/sub-basin shall be presented in Plate-7. Command areas of the projects including those from import and also arable area in the basin/sub-basin as per irrigation Atlas, of the CBIP shall also be indicated in the same Plate.

### **6.3.6. Regeneration:**

Regeneration at the rate of 20% of net water utilization in the basin/sub-basin for irrigation from all existing, ongoing and identified future major and medium projects as also from imports shall be indicated in this para and also presented in a tabular form. No regeneration shall be considered from minor irrigation projects.

#### **6.4 Hydropower needs:**

Details of all hydropower projects existing, under construction and proposed as collected from State Govt. sources and the publication 'Hydropower Potential of India' of CEA shall be indicated in this para. Evaporation losses from storages as indicated in respective projects reports/State Master Plan in respect of each project shall be considered as consumptive use for Hydropower needs and shall be indicated in this para.

Details shall also be presented suitably in the form of Annexure.

#### **6.5 Industrial water needs:**

Details of water requirement for all existing, under construction and future industries collected from State Industries Department shall be indicated in this para supported by suitable annexure. However, in case details are not available, it shall be assumed that industrial water requirement at the ultimate stage shall be of the same order of ultimate domestic water requirement of basin/sub-basin and to be met from surface water requirement.

Regeneration at the rate of 80% of industrial water requirement to be available as return flow to the stream shall also be indicated in this para.

#### **6.6 Salinity needs:**

A lumpsum provision of 10% of 75% dependable yield is to be considered towards salinity control in respect of such basins/sub-basins for which State Govts. have kept necessary provision in their Master Plan.

#### **6.7 Ultimate surface water requirement:**

The ultimate surface water requirement in respect of all needs in the basin/sub-basin shall be presented in this para giving state -wise break up in a suitable tabular form.

## CHAPTER-7

### WATER BALANCE

The water balance position of the basin/sub-basin shall be presented in this chapter in following paras in following fashion:-

#### 7.1 General

The water balance taking into account the availability, import, export, needs and regeneration is given below :-

#### 7.2 Surface Water

Unit: Mm<sup>3</sup>

##### 7.2.1 Availability

a) Gross annual yield

- i) At 75% dependability
- ii) At 50% dependability

b) Surface water import (+)

c) Surface water export (-)

d) Overall availability

- i) At 75% dependability
- ii) At 50% dependability

##### 7.2.2 Surface water requirement for

i) Irrigation by in-basin & imported water

ii) Domestic use

iii) Industrial use

iv) Hydropower needs

v) Salinity control

Sub-total

##### 7.2.3 Regeneration from (+)

i) Domestic use

ii) Industrial use

iii) Irrigation use

Sub-total

##### 7.2.4 Surface water balance

Surplus(+)      Deficit (-)

a) At 75% dependability

b) At 50% dependability

### 7.3 Ground water

	State A	State B	State C	Total
a) Gross ground water potential				
b) Existing Draft				
c) Balance ground water available for irrigation				

## CHAPTER-8

### OBSERVATIONS AND CONCLUSIONS

#### 8.1 Observations

- a) The forest are in the basin/sub-basin for the year in which culturable area is found to be maximum shall be indicated here both in ha. and as percentage of total geographical area of the basin/sub-basin.
- b) The maximum culturable area of the basin/sub-basin both in ha. and as percentage of total geographical area of the basin/sub-basin shall be indicated here.
- c) The net area sown in the basin/sub-basin in the year in which culturable area is found to be maximum shall be indicated both in ha. and as percentage of geographical area of the basin/sub-basin.
- d) The designed annual irrigation and corresponding utilization in the basin/sub-basin by existing projects from surface water shall be indicated here.
- e) The designed annual irrigation and corresponding utilization in the basin/sub-basin by ongoing projects from surface water shall be indicated here.
- f) The designed annual irrigation as proposed by State Govts. in the basin/sub-basin by identified future projects from surface water shall be indicated here.

#### 8.2 Conclusions

- a) The 75% & 50% dependable annual surface water yields of the basin/sub-basin shall be indicated here.
- b) The gross ground water potential of the basin shall be indicated here.
- c) The estimated annual irrigation and corresponding utilization in the basin/sub-basin by identified future projects from surface water shall be indicated here.
- d) Estimated ultimate surface water requirement for all uses (including e-flow) in the basin/sub-basin shall be indicated here.
- e) The ultimate annual irrigation in the basin/sub-basin shall be indicated here both in ha and as percentage of maximum culturable area.



- f) The ultimate estimated import to the basin/sub-basin shall be indicated here.
- g) The ultimate estimated export from the basin/sub-basin shall be indicated here.
- h) The quantum of surplus/deficit of surface water at 75% dependability considering import, Export and regeneration shall be indicated here.