MAHADAYI WATER DISPUTES TRIBUNAL

THE REPORT-CUM-DECISION

OF

THE MAHADAYI WATER DISPUTES TRIBUNAL (Under Section 5(2) of The Inter-State River Water Disputes Act, 1956)

IN THE MATTER OF

REFERENCE NO. 1 OF 2011 RELATING TO WATER DISPUTES OF THE INTER-STATE RIVER MAHADAYI AND THE RIVER VALLEY THEREOF

BETWEEN

THE STATE OF GOA

AND

THE STATE OF KARNATAKA

AND

THE STATE OF MAHARASHTRA

VOLUME - V

(VOLUMESI-XII)

New Delhi 14th August 2018

REPORT OF THE MAHADAYI WATER DISPUTES TRIBUNAL

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Oral Evidence of MW-1 Shri S.N. Huddar for the State of Maharashtra

226. Having discussed the evidence of Shri A.K. Bajaj, expert witness of the State of Karnataka, the Tribunal now proposes to consider the evidence of Shri S.N. Huddar, who has filed affidavit dated 13.09.2015, filed on 15.09.2015 [Volume 163(a)].

227. The Examination-in-Chief of Shri S.N. Huddar, MW1, witness for the State of Maharashtra, was recorded on 22.09.2017. During the course of his Examination-in-Chief, he had produced his affidavit dated 13.09.2015 [Volume 163(a)]. The witness had mentioned that there were certain errors in his affidavit, which need to be corrected. According to the witness, the said errors had crept in, because at the time of filing of his affidavit he had not adverted to Volume 102, filed by the State of Goa on 24.12.2014 and the errors to be corrected were

mentioned by him. The aforesaid corrections, requested by the witness, were permitted to be carried out and the corrections were carried out accordingly.

228. From paragraph 1 of his affidavit it is evident that he retired in September, 2006 from service as the Secretary (CAD), Water Resources Department, Government of Maharashtra, Mumbai.

229. In paragraph 1, 1.1 as well as 1.2, the witness has mentioned about his professional qualifications as well as the expertise he has in the field of hydrology. In paragraph 1.3, he has stated that he was requested by the Government of Maharashtra in August, 2015, to study the water availability in the Mandovi Basin (Mahadayi Basin) and depose before the Tribunal regarding Maharashtra's case for water availability in the Mandovi Basin, as well as Maharashtra's contribution in the Mandovi Basin. He has stated that he is working as an Advisor to the Government of Maharashtra, in the matter relating to Mahadayi Water Dispute. 230. In paragraph 1.4 of his affidavit, the witness has claimed that the Government of Maharashtra had made available the records submitted by all the three riparian States before the Tribunal and that he has acquainted himself with the facts of the Mahadayi river case.

231. In paragraph 2 of his affidavit the witness has discussed the topic of availability of water in river basin and in paragraph 2.4 the witness has mentioned that in order to estimate the availability of water flows, it is essential to obtain data of observed flows, upstream utilization for various purposes, estimation of evaporation losses in the river system and return flows coming back to the river system. According to the witness, the accuracy of assessment of the water availability, thus, depends upon the accuracy of discharge observation, accuracy of utilization data, evaporation losses from water body and availability of return flows from various uses.

232. Brief history of water availability studies carried out in Mandovi Basin is referred to by the witness in paragraph 3 of his affidavit. The witness has referred in paragraph 3.3(a) to the finding recorded by Dr. Swaminathan Committee and has stated that the total runoff based on the assessment of CWPC is as follows:

"River	Catchment area in Sq.Km.	Run-off in Mcum.
Mandovi	1550	3580.04"

233. The witness has thereafter referred to the estimates made by the National Water Development Agency (NWDA), created by the Union Government, to assess the availability of surplus water and "Preliminary Water balance study of Mahadayi (Mandovi) basin in July 1989" as mentioned in paragraph 3.3(b) of his affidavit. According to the witness NWDA used the corelationship for computing the yield series for the period 1901-02 to 1985-86 for the entire basin and the average percentage of non-monsoon observed runoff to gross monsoon runoff at the Ganjim site was worked out and adopted to compute annual yield, which is as under:

"At 75% dependability – 3164 Mm³ At 50% dependability – 5703 Mm³" 234. According to the witness, NWDA has also included in its report proposed import of 227.75 Mcum of water through the ongoing Tillari Project being constructed in Chapora basin, and the total water resources of the basin from surface water as assessed are given as under:

3164 Mm ³		
228 Mm ³		
<u>3392 Mm³ </u>		
5703 Mm ³		
<u>228 Mm³</u>		
<u>5931 Mm³</u>		

235. In paragraph 3.3(c), the witness has referred to the estimates made by CWC and stated that the virgin monsoon runoff data has been converted to depth by dividing the volume runoff by catchment area. It is further stated that regression analysis has been carried out using the monsoon catchment rainfall and concurrent runoff and best fit R-R relation obtained, ignoring inconsistent data of monsoon rainfall/runoff points as

per standard practice. The witness has mentioned the R-R relation thus obtained, as under:

"RO = 0.87891 x P-49.6451 Where RO - monsoon runoff in mm P - monsoon rainfall in mm"

The dependable annual yield figures are given below-

50% dependable yield – 6234 Mcum. 75% dependable yield – 5652 Mcum."

236. The witness thereafter, has referred to estimate made by the State of Karnataka in paragraph 3.3(d) and has stated that Karnataka has furnished the yield from their part of catchment of Mahadayi basin as 1242.23 Mcum (43.87 tmc) at 75% dependability and 1419.49 Mcum (50.13 tmc) at 50% dependability.

237. The witness has referred to Water Availability Estimate for the Mahadayi River Basin by Indian Institute of Science, Bangalore in paragraph 3.3(e) of his affidavit and has stated that the results of the analysis of I.I.Sc, Bangalore, are as under:

"VARIOUS STUDIES CARRIED OUT BY INDIAN INSTITUTE OF SCIENCE (I.I.Sc), Bengaluru

Sr.	Study	Yield @				
No.	carried by	75%		50%		
	Model	Mcum	ТМС	Mcum	TMC	
1	Annual Model	6767	238.98	7171	253.25	
2	Monthly	6354	224.39	6886	243.18	
	Model					
3	ANN Model	5740	202.71	6223	219.77	
4	SWAT Model	5376	189.86	6151	217.23	
					,,	

238. The Goa's estimate has been mentioned by the witness in paragraph 3.3(f) of his affidavit and has stated that the State of Goa has not furnished its assessment of yield from Mandovi basin, in its Statement of Case. According to the witness, the State of Goa got the matter studied from IIT, Bombay and this study has been submitted by the State of Goa to the Tribunal on 22nd December, 2014.

239. The witness has further mentioned in paragraph 3.3(g) of his affidavit, Water Availability Studies for Mandovi River Basin by Indian Institute of Technology, Mumbai (IIT-Powai). The

witness states that the IIT (Powai) has considered the data of Ganjim Gauge site as observed by CWC, but it has converted the discharge measurement considered by CWC by applying the ratio of average flows of float and current meter discharges. The witness has proceeded to mention that it has based its studies on the corrected discharge at Ganjim and considered the rainfall data up to 2005 to arrive at the water availability of the basin. According to the witness, from the study after correcting the discharge and re-estimated rainfall from influencing station, the 75% and 50% dependable annual runoff in the entire Mandovi River Basin is worked out to be 4110.79 Mcum (145.05 tmc) and 4632.178 Mcum (163.45 tmc) respectively. The witness has informed by way of filing his affidavit that they computed the yield by considering the reduced catchment area of Mandovi as 1523 sq.kms. i.e. by deducting the area of 509 sq.km. being saline zone and the 75% and 50% annual yields based on above considerations have been estimated to be 3081 Mcum (109 tmc) and 3472 Mcum (123 tmc).

240. It is also mentioned by the witness that Goa has incorporated the concept of safe yield in the study and the 75% and 50% dependable annual safe yield in the entire Mandovi

River Basin is given as 1986.61 Mcum (70.10 tmc) and 2238.58 Mcum (79.06 tmc) respectively, by further reducing the catchment to 982 sq.km.

241. Thereafter the witness has proceeded to mention the estimate made by Maharashtra in para 3.3(h) of his affidavit. The witness has stated that Mandovi River Basin is being gauged at Ganjim and Collem on Mahadayi and Khandepar tributaries of Mandovi river. The witness has stated that both these sites do not cover the catchment lying in Maharashtra Territory, and the Maharashtra State has established closer grid of rain gauge stations, as well as river gauging station, on its own in its catchment area lying in Mandovi basin. The witness further proceeds to state that the river gauging station in Mandovi basin part situated in Maharashtra has been located at Virdi downstream of confluence of Kattika Nalla and Haltar Nalla and is being gauged since 1986. The witness has further mentioned that Maharashtra has used this river gauging data and rainfall data of rain gauge stations established over last 20-25 years and submitted this study as Document No. 97(a) - Annexure 23 on 26.11.2014. According to the witness, based on the regression analysis and co-relation developed between rainfall and runoff,

Maharashtra has estimated yield from its own catchment of 77 sq.kms., as 171.89 Mcum at 75% dependability and 200 Mcum at 50% dependability.

242. The witness further proceeds to mention that Maharashtra has, however, neither estimated nor carried out any exercise to determine water availability in the entire Mandovi basin, but Maharashtra had participated in the CWC's study carried out in 2001 and 2002. The witness has mentioned that Maharashtra has supported CWC's study for consideration of the Tribunal vide Document (Volume 125) filed on 20.04.2015.

243. In paragraph 3.4 of his affidavit, the witness has stated that based on the above review he had prepared a table showing the water availability estimated by various studies reported above to give the gist and the specific yield which indicates the per sq.km. availability in the catchment is also given in the statement to draw comparison. The table given by the witness is to be found on page 18 of his affidavit.

244. The witness in paragraph 4 has mentioned about water availability in Mandovi Basin. The witness has stated that

CWC as per the study report of March, 2003 has assessed the water availability of entire basin as 5652 Mcum at 75% dependability and 6234 Mcum at 50% dependability. According to the witness, he got the rainfall-runoff relationship derived by CWC, checked the same from his team and observed that the relationship is nearly the same and hence can be relied upon by the State of Maharashtra. The results of the study prepared by his team are enclosed by the witness as Annexure 1 to his affidavit.

245. In para 4.3 of his affidavit the witness has stated that his study, however, does not account for import of water from Tillari basin to Mandovi basin and while estimating the water availability in basin, the imports of water from other basin or diversion of other basin to the basin under study has to be accounted for.

246. What is emphasized by the witness is that as far as the State of Maharashtra and the State of Goa are concerned, he had gone through the agreement between the State of Goa and the State of Maharashtra entered on 06.04.1990, whereby the State of Maharashtra has agreed to supply water to the State of Goa in the ratio of 26.7 : 73.3 from Tillari River Basin. The witness has appended a copy of the agreement as Annexure 2 to his affidavit. The witness states that a part of this water is being utilized by the State of Goa in Mandovi basin for irrigation, domestic and industrial uses and the proportion of use in Mandovi basin has been assessed by NWDA in its Technical Study No. 93 of July, 1989 as 227.75 Mcum. The witness has informed in his affidavit that an understanding recently reached between Maharashtra and Goa has modified the quantum of water to be used.

247. According to the averments made in paragraph 4.4 of his affidavit, in the 101st meeting of the Technical Advisory Committee of Planning Commission, Government of India held on 30.11.2009, the Committee has accepted the revised proposal of Tillari Irrigation Project, a joint venture of Maharashtra and Goa States. The witness has mentioned that as per the revised planning utilization from Tillari Project would be 621.17 Mcum of which Maharashtra will use 161.49 and Goa will use 459.68 Mcum. What is stated by the witness in his affidavit is that the State of Goa as per its revised planning has planned use of 348.215 Mcum for irrigation and 111.465 Mcum for domestic and industrial use. A copy of the summary record of TAC meeting dated 30.11.2009 is produced by the witness as Annexure 3 to his affidavit. The witness has mentioned that part of this water being used in Mandovi basin of Goa needs to be assessed and accounted for while computing the availability of water in Mandovi Basin.

248. In paragraph 4.6 of the affidavit it is emphasized that NWDA has already accounted for the import of water in the study as 228 Mcum and in the 101st TAC meeting, State of Goa's utilization is planned as 459.68 Mcum out of which utilization of 261.33 Mcum is assessed as use in Mandovi Basin.

249. During the course of Examination-in-Chief, the witness produced a Note on Planned Water Utilization of Goa State in Tillari (Chapora) and Mahadayi (Mandovi basin) with extract of pages from CWC Note on Tillari Project for consideration of Advisory Committee on Irrigation and Flood Control, November 2009 and extracts of the Note prepared by Government of Goa for visit of CWC Officers dated 15 to 19.11.2008 is enclosed by the witness as Annexure 4 to his affidavit. The witness has mentioned that taking into account this water import, he has assessed the availability in Mandovi Basin as 5913 Mcum at 75% dependability. According to the witness, the KWDT, after allocating the water has accepted the principle of return flow after development of water use in phased manner and allocated the same and the same principle will be applicable in this case also. What is mentioned by the witness is that the use of water for irrigation and domestic use, approved by the Tribunal, will further generate return flows which would also be available for utilization and KWDT has considered such return flows as 10% from irrigation, 80% from domestic use and 97.5% from industrial use.

250. In paragraph 5 of his affidavit the witness has dealt with water availability from Mandovi Basin part of Maharashtra State and has stated that as per IS 5477(Part-3):2002, about 40 years' data is desirable for hydrological estimation. The witness states that rainfall data which was not observed for the above station was estimated from 1969 onwards and weighted rainfall was derived by Chief Engineer, Planning and Hydrology, Nashik and, accordingly, the report has given the water availability as 171.89 Mcum at 75% dependability and 200.01 Mcum at 50% dependability. The witness has further claimed that he has relied on the observed data available for the purpose of study and he got the studies prepared afresh based on purely observed data for the purpose of estimation of water availability from Maharashtra area lying in Mandovi Basin. The witness further claims that he has prepared the table of actual runoff observed and recorded at Virdi site from 1986 onwards. According to the witness, he has observed from the recorded data that for the year 2005 the data was not recorded, because in this year very heavy incessant rainfall was experienced in Maharashtra and probably site being difficult to access, no record of gauge discharge during floods was kept. The witness claims that he looked into similar rainfall figures in past record of various rain gauge stations in catchment as well as Tillarwadi and observed that the situation is more or less parallel to year 1992 and hence for continuity of series assumed same runoff as of 1992. According to the witness, the assumption is on safer side as it will only marginally influence specific yield figure. The witness has further informed that the catchment area at Virdi R.G. site is 35.43 sq.km. and the actual observed data has been arranged in descending order to find out water availability at Average, 50% and 75% dependability and the same is given as specific yield from Haltar Catchment as 3.40 Mcum/sg.km., 2.97 Mcum/sg.km and 2.39 Mcum/sq.km. The witness has produced detailed Note on studies as Annexure 5 to his affidavit. What is mentioned by the witness is that a comparison of specific yield given in the table under para 3.4 reveals that CWC study shows specific yield of 2.78 Mcum/ Sq. Km. at 75% dependability and 3.07 Mcum/Sq. km. at 50% dependability which is in fair agreement with his computations. According to the witness he had looked into the figures of rainfall in Haltar Catchment vis-à-vis CWC study and observed that the rainfall as per CWC study is more than in Haltar Catchment and hence marginal increase in specific yield revealed by CWC study is justified. Conclusions of the study have been mentioned in paragraph 6 of his affidavit, which are as under:

"6.1 As stated in para 4 covering water availability in Mandovi basin, I consider 5913 Mcum as the water availability in entire Mandovi basin including import component as water availability plus return flows to be evaluated, as the water availability from Mandovi basin for allocation purposes.

6.2 Contribution to the Mandovi basin from Maharashtra's portion is of the order of 184 and 262 Mcum at 75% and average dependability respectively which may be considered for allocation purpose.

6.3 Maharashtra vide its document no. 27 submitted on 2.1.2013 has dealt with the issue of

dependability in para 2.1.5 of this document and I, therefore, request this Hon'ble Tribunal to decide allocation at 75% dependability and average dependability."

251. In the Note on Study about yield of Mahadayi River Basin carried out by Central Water Commission in March, 2003, EXH. MAH/MW1/1, the Gist of Yield Study carried out by HSO, CWC in March, 2003, is mentioned in paragraphs 1, 2 & 2.1 it is stated that this study was carried out with the help of following hydro meteorological data:

"i) The rainfall data for the 15 rain gauge stations located in and around the catchment area has been supplied by IMD, Pune.

ii) The observed runoff data observed at G&D site at Ganjim on Mahadayi river has been collected from the published CWC Water Year Books.

iii) The data for the upstream utilization in the catchment area of Ganjim gauging site."

252. In para 2.2 the witness has explained the methodology adopted in the study. The computation of the yield made by CWC is mentioned in paragraph 2.6 of the Note and it is mentioned that the annual yield series for entire Mahadayi basin

was prepared for the period 1928-29 to 1997-98 i.e. for 70 years and the dependable flow figures with this yield series at 75% and 50% dependabilities are derived as 5652 Mcum (199 tmc) and 6234 Mcum (220 tmc) respectively.

253. In paragraph 3 of the Note the witness has mentioned that the State of Goa was not fully satisfied with the hydro meteorological data considered in the study of CWC and the State of Goa was insisting on analyzing rainfall data including the period from 1901-1931 and that the State of Goa has reservations about the accuracy of flow data at CWC G&D site at Ganjim on Mahadayi river, but the State of Karnataka and the State of Maharashtra had no reservations about the study undertaken by CWC. According to the witness in view of reviewing the yield study carried out by HSO, CWC, the Karnataka assigned the studies on water availability assessment for the Mahadayi river basin to the Indian Institute of Science, Bangalore, and the study "Water Yield Estimates for the Mahadayi River Basin Annual Regression, July 2011" to review the Rainfall-Runoff Model developed in the earlier yield study carried out by HSO, CWC in 2003. The IISc, Bangalore, with data set of monsoon catchment rainfall up to the Ganjim site and
monsoon flows at Ganjim site, has developed the relationship between monsoon catchment rainfall and runoff at Ganjim site as below:

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"R = 0.6256*P + 1297
Where,
R = Annual Monsoon Runoff in mm
P = Annual monsoon catchment rainfall in mm"
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254. In paragraph 5 of the Note it is stated that using the above mentioned relationship, IISc, Bangalore, has assessed the dependable flows of entire Mahadayi basin at 75% and 50% dependabilities and those are 6767 Mcum (238.98 tmc) and 7171 Mcum (253.24 tmc) respectively. The witness has mentioned in paragraph 5 of the Note that the rainfall-Runoff relationship developed by I.I.Sc, Bangalore (2011) is totally different from the relationship derived in the study of CWC (2003) in spite of using same rainfall and runoff data. As mentioned in paragraph 6 of the Note, the State of Goa approached the Indian Institute of Technology, Bombay for developing rainfall-runoff relationship and thereby to estimate the water availability in Mahadayi Basin. In response to this, IITB carried out the study and prepared a report with caption as "Water Yield Studies for Mandovi River Basin – a linear regression approach" and this report has been filed before the Tribunal by the State of Goa in December 2014.

255. Paragraph 7 of the Note proceeds to mention that IITB has taken review of the yield studies of Mandovi river basin carried out so far by various authorities and institutions and in its view in case of CWC (2003) report on yield study of Mahadayi basin regarding Rainfall-Runoff relationship developed in CWC (2003) Report, IITB has also endorsed the remarks raised by I.I.Sc, Bangalore in its Annual Model Report. In the report, IITB has drawn its conclusion which is reported at para 7, page 31 of Volume 163(a) and the same is reproduced hereunder:

"... even though the data length and methodology adopted is same as that of CWC(2003) report, the developed regression equation is entirely different than the equation reported by CWC(2003), leading to different annual runoff values. We have also cross verified the linear regression equation by developing a linear regression model for the same data given by CWC(2003) up to Ganjim site, and obtained the same equation as derived by the IISc. We were not able to get the equation derived by CWC." 256. In paragraph 8, the witness has presented Review of Study by the State of Maharashtra and in paragraph 20 finally it is concluded that the yield figures assessed by HSO, CWC in the CWC (2003) report or now assessed by the State of Maharashtra are based on consistent hydro meteorological data and methodology best fit to the data available and the yield figures arrived at in CWC (2003) and in the review by Maharashtra are very well in agreement and hence the yield figures of either study can be considered for the yield of entire Mahadayi basin. The yield figures mentioned in paragraph 20 of the Note are as under:

Particulars	50% dependability	75% dependability
CWC(2003) Study	6234 Mcum	5652 Mcum
Review by	6206 Mcum	5627 Mcum
Maharashtra		

257. A detailed Note on his study is enclosed by the witness as Annexure 5 to his affidavit. If one refers to Annexure 5, which is to be found at page 79 of the Affidavit, it becomes apparent that Chief Engineer, Planning and Hydrology, Nashik, had determined the water availability by developing composite yield series (Observed yield series + estimated yield series) with

the view to satisfy the requirement of IS 5477 (Part 3):2002 of minimum 40 years length of series for assessing water availability. In order to cross verify, the water availability assessed in the Chief Engineer, Planning and Hydrology, Nashik's report, it was decided to verify it with the estimation of water availability to be decided on the basis of annual observed data and for this the exercise indicated in paragraph 5.1, to be found on page 80 of the affidavit was undertaken.

258. In paragraph 5.2 at page 81 the dependable flow figures and corresponding specific yield figures are reproduced which are as under:

Sr. No.	Exercise/study	Dependable yield figures in Mcum at different dependability (Specific yield in Mcum/sq.km.)		
		Average	50.00%	75.00%
1	Annual flow series on the basis of observed data with filling gap of one year 2005 (Proforma-A)	261.65 (3.398)	228.82 (2.971)	184.24 (2.392)
2	Annual flow series on the basis of only observed data without filling gap of one year 2005 (Proforma-B)	250.37 (3.251)	227.34 (2.952)	183.35 (2.381)
3	Chief Engineer, Planning and Hydrology, Nasik's report	201.26 (2.264)	200.006 (2.597)	171.891 (2.232)

259. This witness was cross-examined by the learned Counsel for the State of Goa in detail and few questions were put to him by the Tribunal also. In answer to question no. 3, put by the learned Counsel for the State of Goa, the witness has stated that neither he nor his team had checked about the selection of the rainfall stations used for computing weighted rainfall at Ganjim. It was stated by him that the selection of the rain-fall stations used for computing weighted rainfall for entire catchment was also not checked by him or by his team. The witness had further stated that following factors were not checked either by him or by his team:-

- a) The selection of the rainfall statins used for computing weighted rainfall at ganjim;
- b) The selection of the rainfall stations used for computing weighted rainfall for entire catchment;
- c) The drawing of Thiessen polygon at Ganjim;
- d) The measurement of areas of Thiessen polygon at Ganjim;
- e) The computation of Thiessen weights at Ganjim;

- f) The drawing of Thiessen polygon for entire catchment;
- g) The measurement of areas of Thiessen polygon for entire catchment;
- h) The computation of Thiessen weights for entire catchment;
- i) The adding of the daily rainfall data, from IMD's files, in order to obtain the monthly rainfall data;
- j) The adding of the daily runoff data, from CWC's files, in order to obtain monthly runoff data;
- k) The filling of the missing rainfall data;
- I) The consistency checks applied to the rainfall data;
- m)Any other checks applied to the rainfall data
- n) The computation of the non-monsoon contribution;
- p) The application of the regression equation to data prior to 1979, and, the preparation of estimated runoff series;

260. In view of the above mentioned state of affairs, a question was put to the witness as to whether the decision not to check the aspects mentioned in the aforesaid sub-paragraphs in the questions was taken by him or by his team or was it taken by

the State of Maharashtra and, if so, at what level. The witness replied that the decision was taken by him to ignore the aforesaid aspects mentioned in sub-paragraphs (a) to (n) and (p) of question No. 3. According to the witness, his approach in preparation of affidavit regarding water availability in the Mandovi basin was to look at the various studies carried out by different party-States and verify whether the reliance placed by Maharashtra on CWC was acceptable or otherwise and, therefore, he did not scrutinize CWC (2003) Report in detail. The attention of the witness was drawn to his study, wherein he had used the data at Ganjim discharge site up to the year 2005 and, therefore, a question was put to him as to why he had not used the data of Ganjim discharge site post the year 2005. The answer given by the witness was that he had not used the discharge data of Ganjim river gauging site up to the year 2005 and what he had done was checking of the correlation equation and applying the equation derived by him to the weighted rainfall given in CWC (2003) Report up to the year 2000, and since he had found IISc, Bangalore study had given weighted rain fall till 2005, he had just computed the yield from this data and found that the same nearly matched with the 75% dependable yield estimated by CWC.

261. A question was put to the witness as to whether the hydro-meteorological data submitted by the State of Karnataka before the Tribunal vide Volume 98, and the consistency analysis of flow data in Mahadayi basin conducted by CWC (Volume 99), was made available to him by the State of Maharashtra. To this question the answer of the witness was that he was not made available the aforesaid Volume 98 but Volume 99 was given to him.

262. Attention of the witness was drawn to page no. 82 of his Report [Volume 163(a)], which is a Note on "Assessment of Water Availability in Maharashtra Catchment area in Mandovi Basin" and a question was asked as to whether before accepting this data he had subjected the said data to any checks. The answer given by the witness was that he had not checked this data himself, but a daily discharge data, which had been submitted before the Tribunal, as Annexure 25(H), Volume 113(a), had been used and got converted into monthly figures, which were then checked by him.

263. In question No. 19, put to the witness by the learned Counsel for the State of Goa, eleven discrepancies were pointed out to the witness in the so called CWC (2003) Report. After pointing out above stated gross errors, the learned crossexaminer had sought the opinion of the witness about errors. The witness responded by saying that he did not agree with the suggestion made in the said question to the effect that CWC(2003) Report was suffering from any gross errors. The fact that, according to the government of Goa, severe discrepancies outlined in question No. 19, were serious enough to affect the sustainability and credibility of the so called CWC(2003) Report, was pointed out to the witness and it was further stated by the learned cross-examiner that by placing reliance on the same in his studies, those very errors and discrepancies had also been carried over in his report and as such those had affected his study report, more so, because the witness had admitted in answer to question No. 18 that except the arithmetic of the R-R regression equation, he had not checked or verified any other thing in the so called CWC (2003) Report. After pointing out the above mentioned relevant factors, the learned cross-examiner had sought the response from the witness.

The witness stated that he did not consider that the discrepancies were serious enough to the yield figure given in CWC Report and that his reliance was on the estimated yield figure. The witness explained that his reliance was not only on account of the regression equation but also on the basis of comparison of specific yields calculated by him on page 18 of his affidavit. According to the witness, the specific yield, on which he had relied upon, was based on comparison of adjoining basin Tillari, wherein the specific yield, which he had verified on the basis of river gauge data of Tilariwadi River Gauging Station from 1973 to 2002, maintained by the Chief Engineer, Hydrology Project, Nashik, Government of Maharashtra. The witness further stated that he had also a look at Volume No. II (Goa), which was a hard copy of CD at Annexure 120 in Volume 31 and Volume I to IV, which was a list of 61 projects in Mandvi River Basin in Goa State for water conservation and regulations for long term development and their salient features prepared by the Panel of Experts of the State of Goa, which indicated that the total catchment area worked out to be 998.93 sg.kms.

264. In question No. 31 put to the witness, the errors committed by the witness in Columns Nos. 8 & 9 of Annexure 18

were brought to his notice and his response was sought. The witness stated that while reading columns nos. 8 & 9 of annexure 18, he had inadvertently misread the title of the aforesaid Columns and had also not looked at the individual projects, but considered the final total figures given in Annexure 18 for comparison.

265. After the cross-examination by Shri Dattaprasad Lawande, learned Advocate General for the State of Goa was over, Shri Mohan V. Katarki, learned Counsel for the State of Karnataka, was requested to cross-examine the witness, but Shri Katarki had stated that he had no questions to ask from this witness.

266. Thereafter certain questions were put to the witness by the Tribunal in order to elicit best information relating to the availability of water in Mahadayi basin. The attention of the witness was drawn to paragraph 1.2 on page 3 of his affidavit, wherein he had stated that after his superannuation from service, the Government of Maharashtra had appointed him as an Advisor on the matter related to Krishna Water Disputes and for obtaining clearances to the various irrigation projects of Maharashtra and till about 2010-11, he had got 40-50 projects cleared from Technical Advisor Committee of Planning Commission headed by Secretary, Ministry of Water Resources, Government of India. Therefore, four sub-questions were put to the witness by the Tribunal. The first question was as to for which specific period did he work as an Advisor to the Government of Maharashtra and the second question was whether any project of Maharashtra in the Mahadayi basin was also identified and included for obtaining clearance from the Technical Advisory Committee as well and whether the Detailed Project Report of Virdi Project was prepared and submitted to Central Water Commission for seeking the clearance of the Technical Advisory Committee and whether the cases for seeking other mandatory clearances including that from the Union Ministry of Environment and Forests were also pursued by him.

267. In answer to the above mentioned questions, the witness stated that he had been appointed as an Advisor initially for Krishna Water Disputes Tribunal from October, 2006 and thereafter, after constitution of Mahadayi Water Disputes Tribunal. According to him, technical clearance of any project from Mahadayi basin was not posed to the Technical Advisory

Committee till about 2010-11 and the Detailed Project Report of Virdi Project of Maharashtra was not submitted to Central Water Commission for seeking the clearance of the Technical Advisory Committee because Virdi Project was planned as a minor irrigation project. The witness further stated that for the projects from the State of Maharashtra, which were posed for technical clearance, for those projects, the Maharashtra Government had sought environment and forest clearance from time to time, which were pursued by him.

268. In answer to question No. 12, posed by the Tribunal the witness mentioned that while preparing his affidavit, his approach was whether the reliance placed by the State of Maharashtra, on CWC (2003) Report was acceptable or not and, therefore, he had not gone into the detailed study to satisfy whether a simple linear equation was appropriate or otherwise. It was claimed by the witness that he had just used the data from CWC and checked whether the regression equation was in order or not and after deleting the inconsistent runoff factor figures, he had verified the equation and since they were nearly the same, he concluded that Maharashtra's reliance on CWC (2003) Report was acceptable. He also admitted that he had not investigated further details nor he had undertaken studies relating to validation of the regression model.

269. A question was put to the witness as to whether he had assessed the quantum of utilizable water for the Mahadayi basin and, if so, what were his findings. Another question was put as to whether he had examined the salient features of the project proposed by the State of Karnataka in the Mahadayi basin and, if yes, what were his findings, particularly in respect of utilizable water. Another question put to the witness was as to whether he examined the salient features of the projects proposed by the State of Maharashtra in the Mahadayi basin and, if yes, what were his findings, particularly in respect of utilizable water.

In answer to the above stated questions, the witness stated that he did not assess the quantum of utilizable water for Mahadayi basin as his deposition was related to availability of the water in the basin and not related to utilization of available water. The witness further admitted that he had not examined the salient features of the projects proposed by the State of Karnataka. As far as the State of Maharashtra was concerned, the witness answered that he had looked at the Master Plan and the salient features of the projects for which report had been prepared and submitted before the Tribunal.

This is the sum and substance of the evidence of Shri S.N. Huddar (MW1).

Oral Evidence of AW-2 Shri Paresh Porob for the State of Goa

270. Having discussed the evidence of four Hydrologists, examined by the three different States, the Tribunal now proposes to consider the evidence of other witnesses examined by the three States.

271. Mr. Paresh Porob was examined as witness, AW-2, on behalf of the State of Goa, and he deposed on Wildlife and Forest in the State of Goa.

272. In Paragraph 2 of his affidavit-in-evidence dated 11.11.2017, filed on 14.11.2017 (Volume 209), the witness has given his educational qualifications, expertise and job profile. The Witness has also stated that in the year 1999, he had worked on a project on Documentation of Flora and Fauna of Sacred Grove

in Sattari Taluka funded by Darwin Initiative UK through Centre for Environment Education, Ahmedabad.

273. The witness has further provided his experience in the field in Paragraph 3(d) and in Paragraphs 4 to 9 about his experience in the works related to Wildlife Conservation. In Paragraph 8, the witness has stated that, he has been associated with the Mahadayi Forest since 1989, and even before the said area was declared as a Wildlife Sanctuary.

274. In paragraph 13 of his affidavit, the witness has referred to National Forest Policy 1988, and has stated that if proposed project for diversion of Madei River waters is allowed, it will be harmful to the ecology, and it will also adversely affect the Wildlife Sanctuaries and in general it will definitely defeat the principal aim of the National Forest Policy 1988.

275. According to the witness, the International Union for Conservation of Nature has identified 531 Biodiverse areas in India, as Key Biodiverse Areas and Bhagwan Mahaveer and Madei Wildlife Sanctuary have been listed in it. The witness states the criteria adopted for this identification are (i) Threatened Biodiversity (ii) Geographically restricted (iii) Ecological integrity (iv) Biological processes and (v) Irreplaceability, which clearly shows that, both these Wildlife Sanctuaries of Goa are internationally recognised and are heritage sites of our country.

276. The witness proceeds to mention that India has been known for its rich Biodiversity comprising of 91000 documented plants, and 45500 species of animals, in its ten biogeographic regions. The witness has averred that Western Ghats have been notified as Natural World Heritage site in the year 2012 with an area of 7953.15 sq.km., stretching from State of Maharashtra, Karnataka, Tamil Nadu and Goa, having a distance of 1600 kms. The witness states that the entire stretch of Western Ghats from North Goa to South Goa, is under the protected area network, which has provided, a corridor for safe movement of Wildlife especially, Macro Fauna like Tigers, Gaurs, Sloth Bears, wild Dogs and Sambhars.

277. According to him, he has photographed much of the rich biodiversity present in the forest of Western Ghats in the State of Goa, and has produced those photographs as Annexure-A to his affidavit. According to the witness, by declaration of Wildlife Sanctuaries and National Parks in Western Ghats of Goa, the State of Goa has, set a perfect example of Gene Pool Conservation, a concept of an age old traditional practice of Sacred Grove in India.

278. The witness has mentioned that Madei Wildlife Sanctuary is the northern most Wildlife Sanctuary in the protected area, having an area of 208 sq.km. spread over the entire Taluka of Sattari and is notified as a Sanctuary on 31st May 1999, under Section 18 and 26 of Wildlife Protection Act 1972.

279. The witness proceeds to state that for better Wildlife Sanctuary, he has categorized the said Sanctuary into two major zones namely: (a) Hilly Tracts; and (b) Valleys.

280. He has mentioned that out of ten valleys, only two Valleys namely Surla Valley and Codval Valley, have perennial stream in the form of Surla Stream in Surla Valley and Mahadayi River in Kodval Valley and he has categorized both the Rivers into three Zones for better understanding of river ecology. The three zones are mentioned in detail by the witness in paragraph 26 and another paragraph which is also numbered as para 26, and Para 27 of his affidavit.

In para 32, the witness has emphasised that any 281. change in vegetation diversity will result in drastic change in diversity of lower life forms like insects, as many species of insects, require a host of plant to breed to complete its life cycle. In paragraph 33, 34, 35, 36, 38, 39 etc., the witness has mentioned as to how the Wildlife would be affected if diversion of water, as claimed by the State of Karnataka is granted. The witness has also referred to Khazan lands and stated that the diversion of water would make them unproductive, affecting thousands of people depending on the Khazan lands. The witness has further made reference to man-animal conflicts which may have an adverse effect on account of reduction of waters. The witness has mentioned that, the balance in aquatic system will be greatly affected, and vegetation type along with the river banks would also be changed drastically.

282. According to the witness there will be reduction in water velocity, resulting in transportation of organic matter and

its deposition. Ill effects of the diversion of water are also detailed in Para 58 of his affidavit.

283. This witness has filed additional affidavit-of-evidence dated 17.11.2017 on 20.11.2017 (Volume 214). The witness has produced a book titled "Biodiversity Profile of Goa" as Annexure-B to this affidavit, whereas the National Forest Policy of 1988 is produced by the witness as Annexure-C to his affidavit. The witness has further stated that he has relied upon International Union for Conservation of Nature, which has identified the Sanctuaries as Key Biodiversity areas, whereas the National Biodiversity Action Plan is produced by the witness as Annexure-E to his affidavit. The witness has further produced a scientific paper which showcases the unique eco-system in the Western Ghats, as Annexure-F, to his testimony, and has produced a document titled "Important Bird Areas (IBA)" as Annexure-G to his affidavit. The witness has also produced a scientific paper "A Conservation Status of Survey of hornbills (Bucerotidae) in the Western Ghats, India" published in Indian Birds Volume 5, No. 4 as Annexure 'H' to his affidavit.

284. The witness has stated that in so far as Forest Management is concerned, 50 Mcum is said to be the requirement, which is as per the Master Plan of Madei basin of May 1999 (in Volume 62 C, Annexure 120, Volume-I), prepared by the Panel of Experts. After reproducing paragraph 5.5.0 on page 53 of the said Annexure, the witness proceeds, to state that Wildlife have the sanctuaries а completely different requirements of their own, and the figure 50 Mcum excludes the water requirement of Wildlife in Madei Wildlife Sanctuary. According to the witness, the total area of catchment of Surla and Mahadayi stem rivers is, 75 sq.km. and 206 sq.km. respectively. The water requirement for Madei Wildlife Sanctuary, is shown, in Table 1.1 which is reproduced below.

Type of	Surla	Madei
Requirement	River	Stem
	(In MCM)	(In MCM)
Domestic	0.325	22.521
requirement		
Livestock	0.05	3.38
consumption		
Irrigation	79.92	1162.43
Environment	124.51	411.20
flow		

(Source: Water balance Study by Mr. S.T. Nadkarni Chief Engineer Water Resource Department, Government of Goa) 285. The paper titled "Impact of Dams and Riparian Frog Communities in the Southern Western Ghats, India", by Rohit Naniwadekar, from Nature Conservation Foundation Mysore, and Karthikeyan Vasudevan from Laboratory for conservation of endangered species, is produced by the witness as Annexure-I to his affidavit to support his statement that reduction in any amount of water will result in drying up of eggs due to lack of moisture, which will in turn disturb the life cycle process of this frog species.

286. The witness has reproduced Table No.1.2 on page 8 of his additional affidavit, which shows the different species of Amphibians, and has proceeded to mention that having regard to the fact that the Wildlife population is on an increase and is likely to increase in the near future, there are plans to increase the water holes and to create more water bodies within the Sanctuary and any depletion of flow of water in the river, will reduce its level and consequently, the quantum of flow, will completely affect the entire Wildlife Sanctuary. The witness has referred to three unique types of eco-systems found in the Western Ghats which are referred to as Myristica Swamps and has stated that they require inundation of water throughout the year and any reduction in the water of Madei river will result in threatening of these unique eco systems and the Fauna therein. It is also mentioned by the witness that the proposed diversion will reduce the flow of water in river Medei and as a result of this, there will be complete drastic and adverse effect on the ecology as well as on the precious Hotspot of Biodiversity.

287. Further, the witness has placed reliance on Table 1.5 prepared by him, Exh. Goa-AW-2/3 (Volume 214) at pages 100 to 103 with input from Water Resources Department, Govt. of Goa, which inter-alia, indicates, the proposed project of river diversion, showing quantum of water to be diverted from upstream of wildlife sanctuaries.

288. Mr. Porob has also specifically pointed out that while water fed through the river is plenty during the monsoon season, as the monsoon progressively approaches, the animals come to rely more frequently on the watering hole, across the Wildlife Sanctuary and Parks. He has mentioned that, as the watering holes start drying towards the end of pre-monsoon cycle of the next year, they are again refilled, with the onset of monsoon and

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increases the flow of the rivers. According to him, if there is abstraction/diversion of water, the availability of water will become scare for all animals, thereby adversely affecting their population.

289. Mr. Porob, has mentioned that, the total 17 water holes have been established in Madei Wildlife Sanctuary, which are fed by the water coming from river Madei, during summer. The total quantum of water, in these water holes, are shown by him in Table 1.3 at page 15 of Volume 214. The same reads as under:-

FOREST PRESENT		WATERHOLES	
	WATER	AND THEIR	
	HOLES AND	QUANTITY	
	QUANTITY OF	ENVISAGED BY	
	WATER	2050	
Madei	17	40	
Wildlife	(17x300 =	(40x300=12000	
Sanctuary	5100 Cum)	Cum)	
Bhagwan	13	48	
Mahavir	(13x300=3900	(48x300=14400	
Wildlife	Cum)	Cum)	
Sanctuary			
Bondla	8	8	
Wildlife	(8x300=2400	(8x300=2400	
Sanctuary	Cum)	Cum)	
Total	11400 Cum	28800 Cum	

Similarly Shri Porob has also estimated the water requirements for the nurseries in respect of Mhadei Wild Life Sanctuary and Bhagwan Mahavir Wild Life Sanctuary and details are provided in table 1.4 at page 17 of Volume 214.

290. This witness was cross examined by the learned Counsel for State of Karnataka. In response to question No.3, as to whether the witness has conducted any scientific study on the quantification of water requirement and forest, flora and fauna and the water requirements of villages in Surla valley and Kodval valley, the witness has answered that as a wildlife manager of the Madei Wildlife Century, efforts were made to scientifically manage the sanctuary, and in the process, scientific observations were made and recorded depending on which prescription for wildlife management is done. He further stated that scientific data base was relied upon from various studies carried out by researchers from various institutes. In respect of details provided in the additional affidavit dated 17.11.2017, the learned Counsel for the State of Karnataka put the question No. 14 wherein he pointed out that the witness has mentioned the quantity of water required in Table 1.1 as 1804.336 Mcum (63.72 tmc), in

Table 1.3 as 28,800 Cum (0.001 tmc) and in Table 1.4 as 1,20,000 Cum (0.004 tmc) totaling 63.725 tmc, but no record in support of the calculations is disclosed. Therefore, the learned Counsel put to the witness that these self-serving calculations are ipse-dixit, without any record of scientific study and wanted to know the response of the witness.

In answer, the witness denied the suggestion. According to him calculations given in the tables 1.1 and 1.4 were taken from Water Resources Department of the Sate of Goa, whereas the scientific observations made by him, on day-to-day basis, on inventory of amphibian fauna of Surla and Codval Valley, were recorded to understand the existence and dependability of this Fauna in Madei Wildlife Sanctuary. The witness had further stated that reduction of any amount of water, in both the valleys will result in endangering and extinction of local species of frogs known as Nyctribatricus.

291. The learned Cross Examiner for the State of Karnataka requested the witness to refer to Volume-I of the Master Plan of Mahadayi/Mandovi river prepared by the Irrigation Department of Government of Goa and turn to page 55 and informed the witness that in para 5.6.4, the requirement of water for different uses in Mahadayi Basin upto 2050 and are calculated and at serial No. 4, 50 Mcum (1.765 tmc) is mentioned against forest management, whereas in additional affidavit, the witness has claimed that, the water requirement of 0.001 tmc in table No.1.3 and 0.004 tmc in Table No.1.4, are required. Further his attention was drawn to the Master Plan, wherein it is mentioned that 158 Mcum (5.579 tmc) is required for salinity control, and thus the total water requirement for forest management, comes to about 7.344 tmc. Therefore it was put to the witness that if this quantification of water requirement of 7.344 tmc were to be maintained or ensured for meeting the forest management and salinity control, there would not be any adverse impact or damage to the environment and ecology in India. After putting the aforesaid suggestion the response of the witness was sought.

The witness denied the suggestion and stated that the quantity mentioned in the Master Plan at page 55 para 5.6.4, referred to in the question, is for forest management at serial No.4, and it should be noted that while preparation of Master Plan, forests are taken into consideration, since Madei Wildlife Sanctuary was not notified at that point of time, the

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requirements of water for Wild Life and habitat maintenance, was not considered. The witness further explained that Tables 1.1 and 1.3 mentioned in his additional affidavit, show the quantum required directly by forest components of Wildlife Sanctuary.

292. The attention of the witness was drawn to para 33 of his affidavit dated 11.11.2017 (Volume 209) and it was put to the witness that on the one hand he has stated that the Madei Wildlife Sanctuary has threatened species of birds, and on the other, the very document relied upon by him clearly shows that main threat to the bird heritage and flora and fauna in the Madei Wildlife Sanctuary, is human encroachment and mining, and therefore, the witness has selectively relied upon the article to show the proposed diversions of the Karnataka Government, which are likely to impact, on the forest of Mahadayi valley, but conveniently he has not adverted to, the preceding part of the article. After putting the suggestions, the response of the witness was sought by the learned Cross Examiner on behalf of Karnataka

The witness, first of all, denied the suggestions and stated that it should be noted that there is no mining activity within the jurisdiction of Wildlife Sanctuary in Goa and hence effect of any such mining activity on avifauna in Wildlife Sanctuary is not there at all, whereas river diversion projects are upstream of Wildlife Sanctuaries in Goa and also on upper stream of Bhimgarh Wildlife Sanctuary of Karnataka, which act as a wildlife corridor for unhampered movement of macro-fauna. The witness has asserted that any activity in upper stream, will result in disturbance to the habitat of avifauna and Gene-Pool conservation will be, greatly affected.

293. Thereafter, Shri Mohan V. Katarki, the learned Counsel for State of Karnataka closed his cross-examination. Therefore, Shri D.M. Nargolkar, the learned Counsel for State of Maharashtra was requested to cross-examine the witness on behalf of the State of Maharashtra. In all the learned Counsel had put six questions to the witness, and question No. 6 was as to whether the witness agreed that any sort of diversion or utilization by any of the States, including the State of Goa, in future, in Mahadayi Basin, would result in adverse impact and would disturb the ecological balance, resulting in total disaster in Mahadayi Basin.

The witness stated that he agreed with what was stated in question No. 6.

294. After the cross-examination of the witness, by the State of Karnataka was over, Shri Atmaram N.S. Nadkarni, the learned Senior Counsel for State of Goa stated that he did not want any opportunity to conduct any re-examination of this witness. Therefore certain questions were put to the witness by the Tribunal to elicit certain information relating to Wildlife etc. The attention of the witness was drawn to what he had stated in para 13 on page 10 of his affidavit dated 11.11.2017, and the attention of the witness was also drawn to MARK-GOA/16 (Colly.), as well as National Forest Report 1988, and witness was requested to inform the Tribunal as to whether he had examined the social and environmental costs and benefits, before arriving at the conclusion that if proposed project for diversion of Madei river water was allowed, it will be harmful to the ecology, and that it will also adversely affect the Wildlife Sanctuaries and in

general defeat the principal aim of the National Forest Policy 1988.

In response, the witness stated that the Government of Goa has notified Forest Wildlife Sanctuary along the stretch of Western Ghats of Goa, for water security and maintaining ecological balance. According to the witness socio-economic conditions of the inhabitants of these areas are depending on the Western Ghats in Goa, and in his earlier affidavit dated 11.11.2017 at para 46 on page 27 he had stated about man animal conflict and its implications on the socio-economic conditions of the people. The witness proceeded to state that the water flowing out from Wildlife sanctuary is being utilised by people for cultivating which is a traditional practice and that is mentioned by him in para 55 on page 31 of his affidavit dated 11.11.2017.

295. The attention of the witness was drawn to para 4.4.1 of the National Forest Policy 1988, and witness was asked as to whether any forest land been diverted from any non-forest purpose, either by the State of Goa or by the State of Karnataka. Another question which was asked was as to whether the diversion of forest land for non-forest purposes had resulted in any change, either increase or decrease, in the water availability, and how many projects related to dams and reservoirs, mining and industrial development, and expansion of agriculture, have been constructed in forest areas and how the availability of water has been impacted, as well the result of implementation of such projects.

The witness answered that he was not knowing if the States of Karnataka and Goa have diverted any forest land for nonforest purposes. The witness further stated that he did not know as to whether the diversion of any forest land for non-forest purpose has resulted in any change in the water availability, and finally he replied that he was not knowing about any project relating to dams, reservoirs, mining, industrial development and expansion of agriculture having been undertaken in the forest area, and therefore, he was not able to comment upon the impact of any such projects on the availability of water.

296. It was brought to the notice of the witness that in several paras of his affidavit dated 11.11.2017, he has mentioned about adverse impact of diversion of water from Mahadayi Basin

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on forest and Wildlife, and his particular attention was drawn to para 54 on page 31 of his affidavit. He was informed that the Tribunal has noticed that the mean of the average monsoon rainfall over the Mahadayi Basin during the years from 1964 to 2005 is 3760.1 MM, and the average monsoon rainfall over the Basin, varies considerably. It was also noticed by the Tribunal that in many years there were considerable variations, in the yield with respect to yield mentioned for in the previous years, whereas there were marked variations in long term as well. Therefore the witness was asked as to whether he had examined the impact of variations in rainfall and consequently in yield from Basin, particularly when the variations were too large, as in the year 1971 and 1972, on the forest and Wildlife. Another question put to the witness was as to how he predicted disaster for the forest and Wildlife because of likely diversion of relatively small fraction of total yield of the Basin.

The witness mentioned that he is not a Hydrologist and therefore is not in a position to answer the first question. The witness proceeded to state that as far as forest and wild-life is concerned, any diversion of water coming to the forest will still result in reduction of water and will also reduce water velocity, which in turn, will harm dissolving of minerals and transportation of organic matter from one area to another and that this has been explained in detail, in para 26 on pages 16, 17 and 18 of his affidavit dated 11.11.2017.

297. The Tribunal finds that the veracity/ authenticity of the figures relied upon by the Water Resources Department, State of Goa, having not been questioned/challenged or discredited by the learned Counsel for the States of Karnataka and Maharashtra, the reliance of Mr. Porob, on such figures may, therefore, be taken, as correct, for the purpose of his statements. It is pertinent to note that, in answer to question No.3 put by the Tribunal, the witness has stated that, while preparing his affidavit, he had taken into consideration, provisions mentioned in National Forest Policy, 1988, and the Tribunal finds that, the various aspects mentioned in National Forest Policy, 1988, and the Tribunal finds that, the various of the developmental requirements, to be maintained in the States of Karnataka and Maharashtra.

298. In view of the above discussions, the Tribunal concludes that the testimony of this witness, can be acted upon, subject to

availability of changes in quantum related information, in other witness's statements/submissions, put forth, on behalf of the State of Goa.

This is the sum and substance of the evidence of witness Mr. Paresh Porob (AW-2).

Oral Evidence of AW-3 Dr. Shamila Monteiro for the State Of Goa

299. Having discussed the evidence led by Shri Paresh Porob, the Tribunal now proposes to discuss the evidence led by Dr. Shamila Monteiro. Dr. Monteiro tendered her Affidavit-in-Evidence dated 11.11.2017 as AW-3, and filed the same on 14.11.2017 (Volume 210).

300. She has filed her affidavit on aspects relating to Mahadayi basin and also on aspects relating to the adverse consequences, which would ensue in case the proposed water diversion plans of the States of Karnataka and Maharashtra are given effect to. 301. In paragraphs 2, 3 and 4 of her affidavit, the witness has mentioned about her educational qualifications, expertise and job profile.

302. In paragraph 5 of her affidavit she has stated that coastal waters are recipient of (a) fresh water as well as, (b) terrestrial derived materials of lithogenic, pedogenic and anthropogenic origin, primarily brought in through river discharge and deposited along the continental shelves and in ocean basins. According to her, the rivers are major sources of organic matters to the coastal environment as they transport organic matter derived from vascular plants and soils through discharge, and terrestrial organic matters, derived from continental land masses is one of the major energy sources, to aquatic and marine organisms.

303. After emphasizing the importance of benthic-pelagic coupling, the witness has stated that, Mahadayi river system is divided into two major ecosystems i.e. a complete Fresh Water ecosystem from the source up to Ganjim and estuarine ecosystem from Ganjim up to the mouth of the river. The witness has mentioned that, Mandovi and Zuari Rivers are two major
water bodies of Goa, draining about 2523 sq. km., corresponding to about 75% of the total geographic area of Goa. The witness has stated that, Mandovi and Zuari estuary are tidal estuaries, interlinked by the Cumbarjua Canal and the freshwater river flow dominates both estuaries during monsoon, whereas the tidal flow dominates during the non- monsoon period.

The witness has informed in paragraph 19 of her 304. affidavit that Mahadayi River is entirely rain-fed and the discharge is highly seasonal in nature. According to her, about 90% of the rainfall in the Mandovi basin occurs, during the summer monsoon, with negligible rainfall during December to April. The witness has proceeded to mention that, the hydrographic conditions, in Mandovi estuary are, significantly different during the dry and wet season and that the Mandovi estuary and its backwaters in the hinterland are governed by mixed tides, with semi-diurnal dominance, whereas seawater intrusion is regularly measured up to 46 km. upstream near Ganjim. The witness has informed through her affidavit that, mixing of sea water and freshwater, and consequently the production of various gradients of physico-chemical parameters has resulted in a manifestation of a unique, fragile, biologically complex and highly sensitive ecosystems, with associated ecotones that act as a link between the marine and terrestrial ecosystem. It is also mentioned by the witness that the unique combination of freshwater and seawater balances the salinity levels and helps the highly specialized ecosystem from a complex food web comprising primary producers, consumers and decomposers, that maintains and sustains, the aquatic fauna, as part of the inextricable food web.

305. In paragraph 30 of her affidavit, the witness has stated that, Mandovi and Zuari estuarine complex has a substantial cover of mangrove forest covering about 2000 Ha, and supports a complex food web, and the total area of mangroves supported, by the Mahadayi River and Cumabarjua, is spread over about 900 Ha. According to the witness, the Mandovi river is associated with about 60% forest cover.

306. In paragraph 31, she has given particulars about aquatic organism whereas in paragraph 32 of her affidavit the witness has mentioned about brackish water species. Further, in para 33 of her affidavit, various varieties of shrimps, prawns, crabs, etc. present in the brackish water of Mahadayi river are mentioned, whereas in paragraph 34, particulars about bivalves are stated.

307. It is mentioned by the witness that Mandovi estuary serves as a critical habitat for many migratory species and serves as a corridor for migration from freshwater to seawater and vice versa. After mentioning that Western Ghats, is now considered as one of the eight "hottest hot spots" of the world, the witness has stated that the Western Ghats, is extremely rich in faunal, floral and fungal diversity with more than 290 species of freshwater fishes. The particulars about freshwater fish species are mentioned by the witness in paragraph 38 of her affidavit and the witness has stated that reduced flow in the Mahadayi basin may alter/reduce biodiversity. According to her, any of the above mentioned perturbation would reduce inflow of freshwater, thus reducing the freshwater levels and there will be an increase in salinity concentration from 0.5 ppt to 2.9 ppt at any location in the estuary, which will lead to changes in water physicochemistry. The witness has further pointed out that marine fishes prefer to breed in waters having salinity less than 26 ppt and an increase in salinity is likely to decrease the ichthyoplankton population which will be reflected as a reduced fishery resource.

According to the witness, an increase in salinity will affect the potamodromous migration of freshwater fish, increasing the probability of extinction of some of the alreadv endangered/critically endangered, freshwater fish species. The witness has stated that the reduced flow in the Mahadayi basin will have an impact on the river water quality, such as, increase in salinity, temperature, decrease in oxygen level, increase in turbidity levels etc. which would lead to a sluggish environment which in turn, would support and enhance growth of aquatic weeds and pests, due to which aquatic organisms, such as, fish, invertebrates and other aquatic fauna will be adversely affected.

308. She has stated that there are about 30,225 fishermen in the State of Goa out of which 11,944 are active fishermen, and additionally, there are about 1,82,821 fisher folk, engaged in allied fishing activities including marketing of fish, processing, net mending and other ancillary work and who are totally dependent on fishing and its allied activities for economic sustenance and thus any change/diversion in the water will directly affect their livelihood, in turn having a negative effect on the local economy. 309. According to Dr. Monteiro, the abstraction/diversion of water by the State of Karnataka will severely impact the survival of these fish, both for the purpose of maintenance of natural habitats, and also on the livelihood of local consumption of fish by the local population, especially in the villages surrounding these regions. Dr. Monteiro has categorically stated that the consumption of fish by the local population in Goa is higher than the national average, so as to signify the importance and relevance of the fish in daily diet habits of the local population.

310. Having stated that the coastal waters of Goa are highly influenced by the Mahadayi River System, it is stated that as it eventually drains into the Arabian Sea, the water makes the coastal waters a nutrient rich fishing zone. What is mentioned by the witness is that the survival of Western Ghats and the continuity of fresh water flow are essential to sustain the rich aquatic biodiversity, which is vital.

311. The witness has filed her additional Affidavit-in-Evidence on 17.11.2017 (Volume 215). In paragraph 3 of the additional affidavit, the witness has mentioned that she had conducted a study on the biodiversity of the fish along the fish landing centers of North Goa from January, 2014 to April, 2014 and that she had identified a total of 134 varieties of fish and 24 varieties of crustaceans and 12 moll scans and included the study area of Mahadayi estuary. The witness has produced her study as Annexure-A to her affidavit. According to her, she had also conducted a study on the fresh water fish biodiversity of Goa and had identified 46 freshwater species. The study carried out from May, 2014 to August 2014, by the witness is produced by her as Annexure-B to her this affidavit. The witness further claims in paragraphs 5 of her additional affidavit that she had conducted a study on the effect of salinity on the growth of Catla and Labeo rohita during the months of July to October 2003 at the brackish water fish farm of the Fisheries Department. The study is produced by her as Annexure-C to her additional affidavit. As stated in paragraph 6 of her additional affidavit, the witness had calculated the quantum of water required for maintaining the fisheries biodiversity during the wet season and dry season based on the Tennant method and, accordingly, in order to maintain the fisheries biodiversity in the present condition, the quantum of water required is 104.928 tmc during the wet season and 1.752 tmc during the dry season. The witness has further stated

that an amount of 52.464 tmc is required during the wet season and 0.876 tmc during the dry season, to maintain the fisheries biodiversity in a moderate condition.

312. In paragraph 7 of additional affidavit, the witness has stated that the average fish catch in the Mahadayi estuary was estimated to be 71046 kg. in the dry season and in the wet season 108485.67 kg. in the year 2016, and therefore, it is stated that the production of fish in an estuary is directly dependent upon the fresh water flow coming in the estuary. The witness has asserted that reduction of this flow during the monsoon season would directly affect the production of the fish and if 23 tmc water is diverted, considering that the total yield of the Mahadayi basin, as per the yield submitted by the State of Goa is 113.5 tmc the aforesaid 23 tmc constitutes almost 20.35% of the total reduction in flow which will drastically and adversely affect the biodiversity of fisheries and also reduce the fish production, apart from causing serious prejudice to marine resources and sustainability of the ecosystem.

313. What is asserted in paragraph 8 of her additional affidavit is that the abstraction and diversion of 20.13 tmc by the

State of Karnataka, and 2.83 tmc by the State of Maharashtra will change the natural flow of the river, affecting the fisheries biodiversity and aquatic habitat, and hence not ecologically sound.

314. The witness has mentioned that she had relied on work done by NIO published as scientific papers in scientific journals which are annexed as Annexure-D to her additional affidavit and she has also stated that she had relied on Salinity ingress data based on the DHI report submitted as Annexure-F [Volume 150(a)] Final Report Volume-1, page No. 62.

This is the sum and substance of the evidence of Dr. Shamila Monteiro (AW-3).

Oral Evidence of AW-4 Shri Rajendra P. Kerkar for the State of Goa

315. Having discussed the evidence tendered by Dr. Shamila Monteiro, Director, Directorate of Fisheries, Government of Goa, the Tribunal now proposes to examine the evidence adduced by Shri Rajendra P. Kerkar, Environmentalist on environmental matters, who has been examined by the State of Goa as AW-4.

316. This witness has tendered his Affidavit-in-evidence dated 11.11.2017 filed on 14.11.2017 (Volume 211). The witness has stated that he is presently working for the awareness of environment, wildlife and forest related issues in the State of Goa and border areas, since the period of the last more than a quarter century. He has further stated that he has filed his Affidavit in order to depose and prove the facts as regards Forest, Flora and Fauna, present in the Mhadei Wildlife Sanctuary, as well the entire drainage areas of Mahadayi River Basin in Karnataka, Maharashtra and Goa. In paragraph 3 of his Affidavit, the witness mentions about his educational qualifications, experience and job profile. The witness has stated that Biophelia Hypothesis suggests that human possesses an innate tendency to seek connection with nature and other forms of life. According to him, his efforts and activities to protect the environment around him had been always without any profit motives or without any hidden agenda and that in the said process, many times, he had to criticize the action of several agencies in Goa, Karnataka and Maharashtra States, but in spite of it, Government of Goa sought his participation in the current proceedings as a witness, which is nothing but a glaring testimony of the right direction, truth and dedication of his actions. After stating that, he had visited the site, where construction work pertaining to the inter-connecting channels at Kankumbi was done by the State of Karnataka Neervari Nigam Ltd., Shri Kerkar informed the Tribunal that the same has been designed for diverting the flow of water from Kalasa Nala and its tributaries to Malaprabha River. According to the witness, he was, and has been monitoring the said work right from the project's foundation stone laying ceremony, which was held on 2nd October, 2006, till date and it has come to his knowledge through information obtained through several RTI Applications filed by him that the State of Karnataka has not obtained any necessary statutory permission and necessary clearances under Environmental Protection Act, Forest Clearance Act and Wildlife Protection Act, but has brazenly continued with the environmentally degrading construction of the inter-connecting channels at Kankumbi till Mid June, 2017, and this construction has resulted in large scale destruction to the environment. According to the witness, there is absolutely no proper environmental impact assessment study, undertaken by the State of Karnataka, before embarking on the construction of such a large scale project and undisputedly on account of work already carried out, an extremely large forest cover area is destroyed on account of felling of trees. The witness has proceeded to state that on account of excavation works, and other works carried out by the State of Karnataka at the Mauli temple site, there has been damage to the said temple.

317. The witness has claimed that he had tried to educate himself with the pleadings, studies, submissions, applications, claim statements, replies and various reports submitted by other experts before the Tribunal, including the issues framed by the Tribunal, and that he proposes to present himself as a witness on the basis of his personal experiences and knowledge, that he gained as a physical explorer, of not only the basin area of the Mahadayi basin, but other areas of the Western Ghats, ethically and without any prejudices. In paragraph 14 of his Affidavit, the witness has mentioned that there was lack of base or preliminary information required for advancing scientific exploration of the Western Ghats region of Goa vis-à-vis its biodiversity. After quoting some portion from a document, named "Current Ecological Status and Identification of Potential Ecology Sensitive Areas in the Northern Western Ghats" published by Ministry of Environment and Forests, the witness has produced the relevant page of the said study as Annexure-II to his Affidavit. According to the witness by reading a technical paper published by the scientists of Indian Institute of Sciences, Bangalore, it is evident that Myristica swamps forest for many rare species diversity, not only in floral diversity, but also faunal assemblages bio-diversity, which modem ecological science can seldom ignore. A part of the study is produced by the witness as Annexure-VI to his Affidavit. The witness has referred to a study prepared by the Institute of Environment Education and Research, Bharti Vidyapeeth, Pune, and stated that the Western Ghats are the most important distribution range for many plants at family and generic levels which have extremely restricted distributions. A partial list of threatened Flora and Fauna in various locations in Northern-Western Ghats, along with critically endangered, vulnerable and near threatened species list, as mentioned in the said study, is referred to by the witness, and the witness has identified all biological species living in a particular defined area as given in all bio-diversity inventory project, as Annexure-VII of his Affidavit. The witness has asserted that the place where Karnataka Government had undertaken the work of Kalasa canal in Kankumbi has been identified as Ecologically Sensitive areas by Western Ghat Ecology Expert Panel, which was re-affirmed as Ecologically Sensitive areas by the High Level Committee appointed under the Chairmanship of Dr. Kasturirangan. The witness has proceeded to state that without caring for Goa's concerns, both Karnataka and Maharashtra were surveying, planning and undertaking projects in the Mahadayi basin, unilaterally, even when the case was being argued before the Tribunal and the State of Karnataka had also drawn plans for diversion of Dudhsagar waters, a cruel decision that tantamount to disappearance of the heritage site existing from much before the formation of the Himalayas. The witness has stated that out of the nine rivers and its several tributaries, the river Mandovi is the only one that fulfills the needs of maximum requirement of water for the State of Goa, whereas the rest of the rivers have high level of salt water intrusion. It is mentioned by the witness that both neighbouring States of Maharashtra and Karnataka where the sources of major rivers and tributaries lie, have not understood the impact of sea level rise leading to salination of Goa's surface and ground water resources. The witness has quoted a research paper published by one reputed scientist of National Institute of Oceanography on the subject Estimation of Flushing Time in a Monsoonal Estuary, using observational and numerical approaches, and has stated that the plan of upstream diversions during monsoon by upper riparian State of Karnataka and Maharashtra are, if implemented, the total flushing time will drastically increase, deteriorating the health of the estuary with irreversible consequences and this aspect has not been covered in the cited DHI Report. The witness further states that quantifying the environmental flow, presents a formidable problem. The witness has, in detail, mentioned about the environmental management classes in detail in paragraph 38 onwards. Thereafter, the witness has made four specific recommendations, which are to be found on pages 39 and 40 and based on four recommendations, the witness has made fifth recommendation in respect of the water requirement for environmental flow which is as under:

Preferred			
Basin/Sub Basin	Annual, 36.8% of MAF	E.F (non-monsoon)	E.F. (Monsoon)
Assnora	35.8	1.32	34.5
Bicholi	87.1	3.40	83.7
Valvanti	89.1	3.48	85.6
Kudne	32.8	1.25	31.5
Kotrachi	102.2	3.55	98.7
Khandepar	339.2	13.00	326.2
Ragda	195.9	7.53	188.4
Surla	124.5	4.21	120.3
Siquerim	0.0	0	0.0
Main Mahadayi	411.2	52.0	359.2
Total MCM	1417.8	89.8	1328.0

ТМС	50.1	3.2	46.9	
Not Less Than				
Basin/Sub-Basin	Annual, 21% of MAF	Non-monsoon	Monsoon	
	in MCM			
1	2	3	4	
Assnora	20.4	1.32	19.1	
Bicholi	49.7	3.40	46.3	
Valvanti	50.8	3.48	47.3	
Kudne	18.7	1.25	17.5	
Kotrachi	58.3	3.55	54.8	
Khandepar	193.5	13.00	180.5	
Ragda	111.8	7.53	104.3	
Surla	71.0	4.21	66.8	
Siquerim	0.0	0	0.0	
Main Mahadayi	234.6	52.0	182.6	
Total MCM	809.0	89.8	719.2	
TMC	28.6	3.2	25.4	

318. The witness was cross-examined by the learned Counsel for the State of Karnataka and State of Maharashtra and certain questions were also put to the witness by the Tribunal. Therefore, the Tribunal proposes to refer to only those questions and answers which are found to be relevant by the Tribunal.

319. A question was put to the witness to the effect that if he was given a chance between providing water to human beings' and providing water to animals, how would he determine his preference. The answer given by the witness was that first priority would be for environment, and he would make his best attempt to look the interest of animals first, and then if water is available, he would make attempt to provide water for human beings. The witness further stated that if the environment is protected, then the same shall take care of human needs also. Another question put to the witness by the learned cross-examiner for the State of Karnataka was that when he had visited the drought prone Malaprabha area, had he noticed the conditions of people in the rural areas, who could not grow even a single rain fed crop due to the lack of water.

The answer given by the witness was this was mainly because of opting for water guzzling cash crop, like sugarcane.

320. The attention of the witness was drawn to the Volume I of Master Plan prepared by the Panel of Expert, approved by the Government of Goa in the year 1999 (Volume 31 of III) which showed that Goa has planned utilization of 72.40 tmc for irrigation. Therefore, it was put to the witness that the Government of Goa itself had ambitious plans for irrigation over the so-called requirement of water for environment and ecology. After bringing the stated facts to the notice of the witness, his response was sought by the learned Cross-examiner.

The response was that whatever plans, Government of Goa has for requirement of water for various purposes, he would always make attempts to understand the needs of the hour, and if plans are against wildlife and ecology, he would oppose the same, as he has done so in past and shall continue to oppose the same in future also.

321. Shri Mohan V. Katarki, learned Counsel for the State of Karnataka had thereafter stated that he had no further question to ask this witness in his cross-examination, and as such he closed his cross-examination.

322. It was put to the witness by the learned Counsel for the State of Maharashtra that his claim that the diversion of 2.83 tmc by the State of Maharashtra, outside the Mahadayi basin, would result in irreversible damage to the environment, and would destroy the rich habitat and further disrupt its ecological balance is incorrect and without any basis. The suggestion put in question No.1 by the learned Counsel for the State of Maharashtra was denied by the witness.

323. Thereafter, the Tribunal had posed certain questions to the witness to elicit more information on the subject.

324. The attention of the witness was drawn to para 37 on page 37 of his Affidavit dated 11.11.2017 and, prima facie, the Tribunal was of the opinion that findings of the Research Report 107 are the basis for further recommendation Nos. 2, 3 and 5 made by the witness on pages 39 to 41 of his affidavit. Therefore, an information was sought from the witness as to whether the findings of the Research Report 107 of IWMI have been critically examined and accepted by the Ministry of Environment, Forests and Climate Change.

The answer of the witness was that as per his knowledge and information, the findings of the Research Report 107 of IWMI have not been examined and accepted by the Ministry of Environment, Forests and Climate Change. It was noticed by the Tribunal that along with his Affidavit dated 11.11.2017, the witness has appended Annexure-IX, being an assessment of environmental flow requirement of Indian River Basins (MARK-GOA/35) and attention of the witness was drawn to page 255 of his Affidavit dated 11.11.2017, wherein, it is stated that:

"The study has effectively not been supplied with observed flow data of reasonable amounts and quality. The date which have been acquired and used were primarily from publicity available sources (Internet) where data are outdated and no conclusion on the accuracy or even origin of the data could be made. If the situation with access to data in India is not changed, any further EFA will be largely speculative...."

325. After the said exercise was over, the Tribunal wanted to know from the witness as to how the results of such study can be considered as reliable and recommended to be adopted for application. The answer given by the witness was that the result derived by using global flow data based and using e-flow calculator helps to get reliable data as per his knowledge.

326. The witness was handed over relevant pages of a document issued by the Ministry of Environment, Forests and Climate Change, in April, 2015 titled as "STANDARD TERMS FOR REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

UNDER EIA NOTIFICATION, 2006" and the attention was drawn to page 48 of the said document wherein it is mentioned that environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season and for remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge. Having so drawn the attention of the witness, a question was put to him as to why he had not considered the above guidelines. The response of the witness was that he was not aware about the guidelines mentioned in the document, MARK/37 and, therefore, he had no comments to offer.

This is the sum and substance of the evidence of Shri Rajendra P. Kerkar, AW-4.

Oral Evidence of AW-5 Shri S.T. Nadkarni for the State of Goa

327. Now the Tribunal proposes to consider the evidence of Shri. Subrai T. Nadkarni, AW5, who has deposed on behalf of the State of Goa.

328. Before taking up the discussion of the evidence tendered by Shri Nadkarni, it would be relevant to notice certain relevant facts.

The Tribunal through an order dated 17.7.2015 had 329. directed the party States to file Affidavit of Evidence of Witness/Witnesses dealing with Hydrology first, because there were serious disputes between the States regarding availability of water. By order dated 1.9.2016, it was clarified that on the next date of hearing the witness/witnesses who has/have filed additional affidavits, on the subject of Hydrology, on behalf of the State of Goa, would be cross examined by the learned Counsel for the State of Karnataka, as well as by the learned Counsel for the State of Maharashtra. It was further directed that after the cross examination of the witness/witnesses, who filed additional affidavits on the subject of Hydrology on behalf of the State of Goa, was over, by the learned Counsels for the States of Karnataka and Maharashtra, the witness/witnesses who have filed affidavits on questions on Hydrology, on behalf of the State of Karnataka, would step into witness box to enable the learned Counsel for the State of Goa and the learned Counsel for the State of Maharashtra, to cross examine him/them, and thereafter the affidavits of other witnesses would be filed.

330. However, while considering the testimony of Shri S.T. Nadkarni, witness on behalf of the State of Goa, the Tribunal vide order dated 23.11.2017 had noticed that his affidavit indicated that he was claiming to be a qualified Hydrologist, and his affidavit, as well as the study appended thereto, indicated that he has relied upon the data furnished in report by Shri Chetan Pandit, and thereafter, has undertaken an independent study regarding yield of sub-basins in the Mahadayi basin. Accordingly, the Tribunal had allowed the deposition of AW5, Shri S.T. Nadkarni, to be recorded and ordered that the affidavit dated 14.11.2017 filed by him, as Examination-in-Chief, shall be read into evidence, even as a Hydrologist.

331. However, to be equitable and fair to the opposite side, the Tribunal had granted a liberty to the State of Karnataka, as well as to the State of Maharashtra, to examine any further expert witness on Hydrology, if so desired, but this liberty granted was never availed of, either by the State of Karnataka or by the State of Maharashtra. 332. In his Examination-in-Chief, the witness has stated that he has filed his Affidavit dated 14.11.2017 in evidence, as a witness appearing for the State of Goa, and that he has sworn the affidavit and has verified his signatures. The witness has further stated that along with the affidavit dated 14.11.2017, he has appended an Annexure-I, which is his CV, giving the details of his qualifications, experience and job profile, etc. The witness has further stated that he has also appended a document, Annexure-II, with his affidavit, which was his determination of Water Availability of sub-basins of Mahadayi basin and Water Demands for Mahadayi Basin and its Sub-Basins. He has also produced on record a report of the Western Ghats Ecology Expert Panel submitted to the Ministry of Environment and Forests, Government of India. He has further produced on record "A REPORT of the High Level Working Group on Western Ghats", issued by the Ministry of Environment and Forests, Government of India, on April 15, 2013.

333. In paragraph 2 and 3 of his affidavit dated 14.11.2017, (Volume 208), the witness has mentioned about his educational qualifications, experience, expertise and job profile. The witness proceeds to state that the State of Goa is the smallest of all the States in the country, and yet it shows an astonishing diversity of endemic species, habitats and ecosystems. In paragraph 8 of his affidavit, the witness has classified the soil in the State of Goa as laterite, alluvial and sandy and that the major portion of the soil is of lateritic category. The witness has stated that lateritic soils are highly acidic in nature, sandy loam to silt in texture and well drained and are poor in lime, phosphorus and potash, but are fairly good in organic matter and nitrogen. According to the witness, alluvial soils are subject to inundation by saline water and are to be protected by bunds. The witness has mentioned that coastal land comprises a stretch of land which can be exploited for irrigation and multiple cropping and these soils are also acidic, sandy, loam and fairly rich in organic matter but deficient in phosphate and potash. The witness claims that there are three main types of paddy lands viz. Khajan, Kher land and Morod land and the local cultivators distinguish the different types of fields according to soil and rainfall condition and its nearness to the river side. The witness has also mentioned that the State of Goa is an important producer of commercial crops such as cashew nuts, coconut, areca nut, pineapples, mangoes etc. The witness has further stated that fruits such as mango,

pineapple, banana, papaya, jackfruits etc. account for 27 per cent of the area including that under horticultural crops.

334. According to the witness, Mahadayi which is also called as Mandovi, is the biggest river basin of Goa and the basin area of Mandovi in Goa is 1580 sq.km., which constitutes 42.70% of the area of the State itself. The witness has mentioned that with most of the rivers in the State being prone to tidal effects, almost 20-40 kilometers along its length, Mahadayi is the main river and practically a life line for the sustenance of the State of Goa and the agricultural needs of its people.

335. In paragraph 14 of the affidavit, the witness has mentioned that the Mahadayi River rises in Jamboti Ghat, about 10 kilometers north-east of Sonasagar near Degaon Village in Khanapur Taluka, Belgaum district of Karnataka State, at an elevation of about 940 meters above the mean sea level. After mentioning the latitudes and longitudes, the witness has averred in his affidavit that, from its origin, for the first five kilometres, the river flows in north-east direction and then flows approximately westwards till it enters the State of Goa near Villages Krishnapur and Codal on border of Karnataka and Goa

The witness has informed that in Karnataka, respectively. Mahadayi river is joined by three important tributaries namely Bail Nadi, Kotni Nadi and Bhandura Nallah and flows through the Bhimgad Wild Life Sanctuary in Karnataka and Mahadayi Wild Life Sanctuary in Goa. The witness further proceeds to state in para 15 of his affidavit that river Mahadayi is joined by Surla river near Nanode about 7 km., downstream from the point where Mahadavi enters Goa. According to the witness, the Kalasa Nallah originates near the Mauli Temple and flows in westerly direction for about 5 km., where it joins the Surla Nallah and then flows in a southerly direction as Surla or Nanode River. According to the witness the flow in the river Mahadayi and its tributaries reduces drastically in the non-monsoon and due to shortage of water in the rivers, the water has to be pumped from the mining pits into the river to provide water to Opa Water Treatment Plant and also Assnora Water Treatment Plant, for meeting drinking water needs of Bicholim, Bardez, Ponda, Tiswadi and other Talukas, and therefore, as an inland waterways, is a way of life and life line of Goa. Diversion or abstraction by the State of Karnataka of any water will severely affect needs of water for Goa, including the navigational traffic. The witness has provided detailed breakup of the catchment areas of sub-basins of Mahadayi River in paragraph 29 of his affidavit. The demands of various uses in the sub-basins of the inter State Mahadayi river vis-à-vis the requirements of water availability is as per Annexure-II, the synopsis of which is reproduced by the witness in para 30 of his Affidavit. After referring to the demands of various uses in the sub basins as reproduced in para 30 of his affidavit, the witness has expressed a view that Mahadayi Basin is a water deficit basin and when seen as a whole basin or as a subbasin, one can clearly conclude that no waters can be diverted. The witness has mentioned that diversion if permitted, would change the Mahadayi river profile and will permanently and adversely affect the ecology of the estuarine region of the river, particularly the Khazan Lands. According to the witness, the State of Karnataka envisages to divert 20.13 tmc of water outside the basin to Malaprabha basin or Supa Reservoir citing shortages for drinking water and also fulfilling irrigation and hydropower needs, which is wholly inaccurate claim, because in fact, the State of Karnataka has sufficient water in the Malaprapha River. What is claimed in the affidavit is that in lieu of utilizing the waters in a planned, organised, systematic and interacted manner of River Malaprapha, the Karnataka is planning to divert the Mahadayi waters to Malaprapha Reservoir. The witnesses has stated that two Nallahs namely Joul and Bennihalla, whose basin area amounts to 5048 sq.km., which is almost more than double the area of Mahadayi basin and it is on record that 50% dependable yield and 75% dependable yield of those two rivers is to the tune of 16.39 tmc and 10.92 tmc, respectively, out of which only 1.50 tmc is being utilized. The witness has stated that Karnataka is planning to divert 7.56 tmc from Kalasa-Bhandura to Malaprapha for fulfilling the drinking water needs of twin city of Hubli -Dharwad and villages on the way, but the proposal is made without citing the existing present resources like Renukasagar Lake or provision of 0.216 tmc from Malaprabha Dam. After mentioning that the water supply demand itself is on a conservative scale, it works out to be about 2 tmc or so, and it is stated that major part of the need is already met from the existing sources and any additional requirement can be met by drawing water from nearby rivers in the State like Bedti and Kali. The witness has emphasised that the State of Karnataka has not properly conceived and planned its available water resources and massive industrialization in water scarce areas, allowing huge growth of water guzzling crops like sugar cane in the Malapraha basin are some of the mis-managements, which have resulted in bloated figures of drinking water demands, only to justify the diversions. The witness has asserted that the small provision of only 0.216 tmc needs for drinking purposes in Malaprabha project, itself shows poor planning and the mismanagement of drinking water. According to the witness, water of an inter-State river does not alone belong to the State of Karnataka and the demands made by the State of Karnataka and State of Maharashtra, for trans-basin diversions, would result in irreversible destruction of not only the water bodies, but also ecology, bio diversity and environment at large. In paragraph 47(b) of the affidavit, the witness has stated that the projects planned by Karnataka and Maharashtra are in highly ecosensitive zones and permission to the Karnataka and Maharashtra for diversion of water outside the basin would eventually lead to diversion of waters flowing through the six Wildlife Sanctuaries and National Parks. According to the witness, the State of Goa objects to that abstractions or diversions of water from the river basin by the States of Karnataka and Maharashtra because the diversion would cause a huge damage to the ecosystem.

336. The water demand and availability for Mahadayi basin and its sub-basins is mentioned by the witness in Annexure –II

appended to his affidavit. The witness has stated in para 4 of Annexure II that excluding the 509 sq.km. area from where water cannot be harnessed and utilized for various reasons, as described in the Amended Statement of Claims of the State of Goa, Volume 131 page 25, the remaining basin of Mahadayi river in Goa covers an area of 1071 sg.km. and extends over seven The witness maintains that Mahadayi basin in Goa Talukas. encompasses 200 villages and also the cities of Panjim, Mapuca, Bicholim, Sanguelim, Valpoi and Ponda and 34.90% of the population is rural and 65.10% is urban. The witness has made a mention of the fact that there is a large floating population of tourists, as Goa is an international tourist destination. The witness has emphasised that the estimate, arrived by the Panel of Experts was a conservative estimate, without having the advantage of considering the important features which were responsible for bringing about a major change in the profile of the river. According to the witness, the said Panel of Experts had estimated the total water requirement of the State of Goa in the Mahadayi Basin as 2674 Mcum (94.12 tmc) and that when the Panel of Experts was appointed by the State Government, the situation and circumstances, as existing in the State of Goa, were completely different and indeed certain events since 1998 have completely changed and brought about a paradigm shift not only in the demographic estimates, but also in the consequential requirements of water, for the State of Goa, all of which were either not available to the Panel of Experts nor could they have been foreseen at that time. The witness proceeds to state that a large migrant population has settled in the State of Goa, dramatically changing the demographic features of the State. After referring to the reports pertaining to the study of hydrology of the Mahadayi basin submitted before the Tribunal, the witness has offered his comments of CWC study 2003, in paragraph 9 of his affidavit. The witness has offered his comments on the study prepared by Shri S.N. Huddar who is examined as an expert witness of the State of Maharashtra, in paragraph 10 of Annexure II, whereas comments offered on the study prepared by Prof. A.K. Gosain, who is examined by the State of Karnataka are to be found in Paragraph 11 of Annexure II. The witness has mentioned reasons for accepting Study prepared by Shri Chetan Pandit, an expert witness examined by the State of Goa, which are in paragraph 12 of his Annexure II in page 39 of his affidavit. The witness has stated that Mahadayi river flows sustain forest and wild life in the Wild Life Sanctuaries and National Parks in the basin. According to the witness, in the State of Goa, Mahadayi basin has Mahadayi Wild Life Sanctuary in Sattari, Bondla Wild Life Sanctuary in Ponda, Sattari and Dharbandora Talukas, Dr. Salim Ali Bird Sanctuary in Tiswadi and Bhagwan Mahavir Wild Life Sanctuary in Sanguem admeasuring about 448.50 sq.km. in the basin. The witness has further informed that the basin has also Bhimgad Wild Life Sanctuary in Karnataka admeasuring about 191 sq.km., which is contiguous with the Wild Life Sanctuary in Goa.

337. In Table No. 9 the witness has brought out, information regarding the sub-basin wise cultivable area in Mahadayi basin in Goa State in hectare (Ha) which reads as under:

Sl. No.	Sub-basin	Cultivable area (in Ha)
1.	Ragada	5267.00
2.	Khandepar	18205.00
3.	Kotrachi	6308.00
4.	Kudne	4905.00
5.	Valvanti	3450.00

6.	Bicholim	2605.00
7.	Assnora	3450.00
8.	Surla	2960.00
9.	Siquerim	601.00
10.	Madei	43053.00
	Total	90804.00

338. In Table No. 10, the witness has mentioned sub-basin wise requirement of drinking water per annum in Mahadayi basin in the State of Goa which reads as under:

"Sub-basin requirement of drinking water in Mahadayi basin in State of Goa:

SI. No	Sub-basin	Population	Rural	Urban	Total in
		(2051 AD)	Requirement	requirement	Mcum
			in Mcum	In Mcum	
1.	Ragada	11626	0.104	0.373	0.477
2.	Khandepar	96652	0.862	3.100	3.962
3.	Kotrachi	15035	0.134	0.482	0.616
4.	Kudne	48305	0.431	1.550	1.980
5.	Valvanti	22238	0.198	0.713	0.912
6.	Bicholim	34463	0.307	1.106	1.413

7.	Assnora	29563	0.264	0.948	1.212
8.	Surla	7918	0.071	0.254	0.325
9.	Siquerim	62294	0.555	1.998	2.554
10.	Madei	549349	4.899	17.622	22.521
	Total	877443	7.824	28.147	35.971

339. In Table No.11 the witness has provided Sub-basin wise irrigation requirement in Mahadayi basin in Goa State which is as under:-

"Sub-basin wise irrigation requirement in Mahadayi basin in Goa State according to the witness, are as under:

SI.	Sub-basin	Cultivable	Water
No.		area (in Ha)	requirement
			(in Mcum)
1.	Ragada	5267.00	142.21
2.	Khandepar	18205.00	491.54
3.	Kotrachi	6308.00	170.32
4.	Kudne	4905.00	132.44
5.	Valvanti	3450.00	93.15
6.	Bicholim	2605.00	70.34

7.	Assnora	3450.00	93.15
8.	Surla	2960.00	79.92
9.	Siquerim	601.00	16.23
10.	Madei	43053.00	1162.43
	Total	90804	2451.73

340. The Table No.12 prepared by the witness relates to Sub-basin wise demand of various uses in Mahadayi basin in Goa (in Mcum) which reads as under:

Sub-basin wise demand of various uses in Mahadayi basin in Goa (in Mcum):

Basin	Dom- Estic	Live- Stock	Tour- ism	Indu- stries	Irriga- tion	Forest Mgmt	Environment		Total Requirement	
							Recom- ended	Mini- mum	Recom- ended	Minimum
Ragada	0.477	0.07			142.21		195.93	111.83	338.69	254.59
Khandepar	3.962	0.59			491.54		339.20	193.50	835.29	689.59
Kotrachi	0.616	0.09			170.32		102.25	58.35	273.28	229.38
Valvanti	0.912	0.14			93.15		89.08	50.78	183.28	144.98
Bicholim	1.413	0.21			70.34		87.10	49.70	159.06	121.66
Assnora	1.212	0.18			93.15		35.82	20.42	130.36	114.96
Surla	0.325	0.05			79.92		124.51	71.01	204.81	151.31
Siqueri	2.554	0.38			16.23		0.00	0.00	19.16	19.16
Kudnem	1.980	0.30			132.44		32.75	18.75	167.47	153.47

Madei	22.521	3.38			1162.43		411.20	234.60	1769.02	1592.42
stem										
			23.07	96.42		50.00				
Total	35.97	5.39	23.07	96.42	2451.73	50.00	1417.84	808.94	4080.42	3471.52

341. The witness has further provided information relating to availability vis-à-vis demands, sub-basin wise (in Mcum) in Table 13 which reads as under:-

Table 13:

"Availability vis-à-vis demands sub-basin wise (in Mcum):

SI.	Basin/Sub-	75%	Recommended	Minimum
No.	Basin	dependable	demand	requisite
		yield		demand
1.	Ragada	465.40	338.69	254.59
2.	Khandepar	803.10	835.29	689.59
3.	Kotrachi	219.30	273.28	229.38
4.	Valvanti	214.90	183.28	144.98
5.	Bicholim	210.20	159.06	121.66
6.	Assnora	81.70	130.36	114.96
7.	Surla	259.90	204.81	151.31
8.	Siquerim		19.16	19.16
9.	Kudnem	77.00	167.47	153.47
10.	Madei	951.80	1769.02	1592.42
	stem			
	Total	3283.30	4080.42	3471.52
342. The witness was cross examined by the learned Counsel for the States of Karnataka and Maharashtra. Certain questions were put to the witness by the Tribunal also. Having regard to the fact of the case, the Tribunal proposes to refer to the relevant questions and answers thereto.

343. The attention of the witness was drawn by the Learned Counsel for the State of Karnataka to his affidavit dated 14.11.2017, and he was requested to turn to pages 61 and 62. It was pointed out to the witness that in Table 8, the water availability of Surla Sub-basin from 1964-2005 as given by the witness is 9.20 tmc at 75% dependable yield, whereas the water requirement of Goa in Surla sub-basin, as mentioned by the witness is 79.92 Mcum (2.82 tmc). The attention of the witness was also drawn to DPR of Kalasa diversion-2010 (Vol. 19) wherein the diversion planned by Karnataka from Surla River (Kalasa Nallah) to Kalasa Dam and Malaprabha Dam is indicated to be 3 tmc and thus the total utilization planned by Karnataka and Goa is 5.82 tmc and even after considering the calculation of Surla sub-basin made by the witness as 9.20 tmc and even after considering the utilisation of 5.82 tmc planned by both the States, there would be, still a surplus of 3.38 tmc for meeting the needs of environment concerns, and therefore it was put to the witness that there would not be any damage or adverse effect on the ecology and environment in the Surla valley on account of diversion planned by the State of Karnataka.

The witness responded by stating that in para 15 of his Affidavit at page 9 he has illustrated the origin of Surla river till its confluence with River Mahadayi and what was being compared was only the irrigation requirement in Table 11 which is at page 64. While answering question No.3, the witness has reiterated that Surla River flows through the Mahadayi Wildlife Sanctuary and any diversion of water flowing into or outside is not permissible as per Section 29 of the Wild Life (Protection) Act 1972. The witness has further mentioned that from the analysis made, though some surplus water looks apparent, the whole Mahadayi system has to be looked into as a whole before deciding about any diversion. After referring to Table No. 13 of page 65 at Sl. No.10 the witness stated that it shows that the availability in the main Mahadayi stem is 951.80 Mcum and the demand including the e-flows is 1769.02 Mcum. The witness has further asserted that the apparent surplus water, referred to in

question No.3 will have to make good the deficit in the main Mahadayi stem. The witness has reiterated that there would be definitely a huge damage to the environment and ecology, in case any water is diverted from Surla River or its tributaries.

344. The witness was shown a map prepared by the State of Karnataka, super-imposing Mahadayi Wildlife Sanctuary and Bhimgarh Wildlife Sanctuary, and it was stated on behalf of the State of Karnataka that, it was clear that none of the project sites, of the projects planned by Karnataka fell within the contours of Bhimgarh Wildlife Sanctuary, whereas 8 projects named in the question, planned by the State of Goa, fell within the contours of Madei Wildlife Sanctuary. After bringing these facts to the notice of the witness his response was sought.

The witness in his reply has mentioned that on the map so marked, and handed over to him, the said projects have been marked to fall in Madei Wildlife Sanctuary but, even some diversion projects of Karnataka, as indicated in some documents, and the project reports submitted by the State of Karnataka, before this Tribunal indicate that the projects of Karnataka do fall in the Bhimgad Wildlife Sanctuary or on the fringes of it.

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345. The witness was shown an extent of saline area in the State of Goa, as indicated in the National Wetland Atlas with regard to Goa, prepared by the Space Application Centre, Indian Space Research Organization, Ahmedabad. The table prepared by the Chief Engineer (ISW), WRDO, Bangalore, Karnataka indicating the saline area in the Mahadayi basin of the State of Goa was also shown to the witness. After showing the above mentioned documents, it was put to the witness that the wetland area in Goa is not more than 8486 hectares as compared to geographical area of 3,07,200 hectares which forms only 2.29 per cent and on this basis the wetland area in Mahadayi basin, which according to the State of Karnataka is the saline area, comes to only 36.18 sq.km. (3618 hectares). In view of these facts it was put to the witness that Goa was unjustified in claiming exclusion of 509 sq.km. (50,900 hectares) from the consideration in the estimation of the total yield of the Mahadayi basin, and the response of the witness was sought.

In reply, the witness has stated that the area of 509 sq.km. is absolutely justified to be deducted from consideration in the estimation of the total yield of Mahadayi basin. The witness has informed the Tribunal that he had moved throughout the basin, especially in the estuarine region and the area of 509 Sq.km. is the area which excludes the saline reaches of the Mahadayi River and its tributaries, and even small rivulets are falling, directly into the sea/saline reaches. The witness has further stated that the calculations in Table MARK-KA/22, are just pro rata calculations of the alleged coastal wetlands as calculated by the State of Karnataka, and do not in any way correspond, to the saline reaches to be excluded for the yield purpose.

346. In question No.15, the witness was shown a statement prepared by the State of Karnataka based upon the Detailed Project Reports (DPRs) filed by the State of Goa before the Tribunal and he was requested to refer to Master Plan of Goa (Volume-31, Page 55 of Volume-1 – GOA). After showing the statement, the witness was told that the water utilization planned by Goa in the Master Plan is 2050 Mcum (72.4 tmc) but the DPRs filed by Goa are only in respect of 61 projects for utilization of 29.72 tmc as shown in MARK – KA/23 and thereafter it was put to the witness that by failing to file the DPRs in respect of 42.68 tmc (72.4-29.72 tmc), Goa has abandoned its claim to that extent and response of the witness was sought on the said

aspect. In answer, the witness has denied the suggestions made in the question. The witness has sought support to his claim from made by the State of Goa, in the Amended the statements Statement of Claims (Volume 131, page 15 para 18D(i)); wherein it is clearly mentioned that the demands of the State of Goa go well beyond the DPRs of 61 projects envisaged in the Master Plan. The witness has further mentioned that he has brought to the notice of the Tribunal his observations on the Master Plan prepared by Panel of Experts of Goa, which are to be found in paras 5 and 6, on page 29 of Annexure-II appended to his affidavit. The witness has asserted that the demands of the State of Goa have been worked out for each use and the same can be seen from Table 12, which is page 64. The witness was asked a question as to whether he can cite any inter-State or International River, where the natural flow is sought to be protected by the basin States, in the manner, as demanded by Goa in this case. The answer of the witness was he could not cite any such river either in India or any other country but maintained that National Water Policy, 2012 is very clear on the concept of environmental flow as per Clause 1.3 (v) of the said policy.

347. After the cross examination of the witness by Shri Mohan V Katarki, the learned Counsel for the State of Karnataka was over, the witness was cross examined by Shri D.M. Nargolkar, the learned Counsel for the State of Maharashtra.

348. It was put to the witness that his claim about exclusion of area of 509 sq.km. from the total area of 2032 sq.km. in Mahadayi basin, on the ground that the said water could not be harnessed and utilized is incorrect and baseless and the response of the witness was sought.

In response the witness denied the suggestion. It was further put to the witness that the claim of the witness that diversion of 2.83 tmc by the State of Maharashtra outside the Mahadayi basin which is a relatively small fraction of the total yield of the basin, would face an imminent threat of choking and would disturb the ecology and would result in irreversible destruction of water bodies and bio-diversity and environment, is incorrect and without any basis.

In answer the witness denied the said suggestion.

349. Thereafter, Shri D.M. Nargolkar, learned Counsel for the State of Maharashtra had made a statement that he has no further questions to ask to this witness and as such closed his cross examination.

350. Shri Dattaprasad Lawande, the learned Advocate General for the State of Goa stated that no opportunity for any re-examination of the witness was required.

351. Thereafter, certain questions were put to the witness by the Tribunal to elicit the best information regarding availability and demand of the water. The attention of witness was drawn to para 28 on page 13 of his affidavit dated 14.11.2017, and the witness was asked a question as to whether any scientific study has been undertaken and/or completed by the Government of Goa to examine the impact of diversion of water outside the basin and/or abstraction of water within the basin by co-basin States including the State of Goa, for meeting the demand of water for various purposes such as drinking water, irrigation, power generation, industrial needs, navigation etc. Another question which was put to the witness was that was there any study undertaken by the State of Goa indicating the impact of diversion/abstraction of water for various purposes on navigation in quantitative terms.

352. Before giving answers to the questions, the witness has stated that before submitting the Statement of Claims and the Amended Statements of Claims of State of Goa, he had read each sentence and all paragraphs of the said Statement of Claims and Amended Statements of Claims, respectively, and he reiterates and stands by each sentence and paragraph in the said The Statements. witness has stated that the said Statements/Pleadings be considered as his evidence on oath.

353. According to the witness, the State of Goa had made attempts to examine the impact of diversion/abstraction of water outside the basin by all the three States on navigation but due to absence of data on sedimentation, at Ganjim G & D, no inference could be drawn from the said exercise especially with regard to navigation. The witness has further stated that there would be definitely some effect, if water is diverted to outside the basin, as utilization in the basin itself will result in return of flows in the river. It was pointed out to the witness that in the Table mentioned in para 30, on pages 14-15 and in the Table 13, on page 65 of his affidavit dated 14.11.2017, (Volume 208), he has indicated the sub-basin wise availability of water in Mcum at 75% dependability in the second column, whereas in the third column, he has indicated the recommended demand and in the fourth column the minimum required demand of water is indicated.

354. With reference to the above facts, the witness was asked as to what did he mean by the term "recommended"? and who had recommended these values. It was pointed out to the witness that he has indicated the availability of water in Sinquerim sub-basin as "-" and does it mean that the catchment area of Sinquerim sub-basin is outside the usable part of the Mahadayi basin as described by the witness in para 14 on page 40 of Volume 208.

The witness has answered that the term 'recommended demand' means the demand required for keeping the whole basin in the same state of environment and biodiversity. The witness has, further clarified that the whole Sinquerim sub-basin is prone to saline effect and falls in the 509 sq.km. and therefore the availability of water is taken as nil. 355. Attention of the witness was drawn to the Table to para 30, on pages 14 and 15 and Table 13 on page 65 of his affidavit dated 14.11.2017, (Volume 208), wherein the witness has indicated the sub-basin wise availability of water (in Mcum) at 75% dependability in the second column. It was noticed by the Tribunal that the total availability of water at 75% dependability has been shown as 3283.30 Mcum (115.9 tmc) and a question was asked as to why he has undertaken sub-basin wise assessment of water availability at 75% dependability and to sum up to arrive at a new yield figure for the Mahadayi basin.

The answer given by the witness was that he had carried out the arithmetic, by adding up the 75% dependable figure to find overall excess deficiency but he agrees, that for the whole basin, the overall of 75% dependability would be the effect of 13 Stations as evaluated by Shri Chetan Pandit, and that he stands by Shri Chetan Pandit's result of 113.5 tmc for the whole basin. The witness has also stated that he had taken up sub-basins study, as he wanted to evaluate as to what would be the effect of availability and demands in each sub basins. 356. It was mentioned to the witness that in the Table mentioned in para 30 on pages 14 and 15, and in the Table 13 on page 65 of his affidavit dated 14.11.2017, the witness has indicated the sub-basin wise availability of water in (Mcum) at 75% dependability in the second column, whereas, in the third column he has indicated the recommended demand and in the fourth Column, the minimum required demand of water is indicated.

357. On the basis of the information supplied by the witness, a question was put to him as to why he had not chosen to consider the total area of the sub-basin, falling in all the co-basin States, for assessment of water availability as well as demands of water for various purposes. On consideration of the figures indicated in the Table on page 15 or in Table 13 on page 65 of his affidavit, it was found by the Tribunal that the overall demand for water is more than the availability of water, and obviously, all the identified demands cannot be fully met either. Therefore, a question was put to the witness as to how did he plan to address such a situation, particularly with reference to prioritization of different projected demands, keeping in view the provisions of the National Water Policy 2012, and/or State Water Policies.

In answer, the witness has stated that his study is basically to study the demands of each sub-basin. He has claimed that inbasin demands of Karnataka are 1.857 tmc and that of Maharashtra are 3.53 tmc, as envisaged in their respective Statements of Claim and he has tried to find out sub-basin wise details, which he could not find in the documents and therefore, he had restricted the same, to the in-basin demands of the State of Goa itself. The witness has further added that the demands in Goa itself being more than 75% dependable flow in the river Mahadayi, confirms the fact that the basin is deficient. He has also stated that National Water Policy 2012, recommends sensitization of the demands within a basin, and it should be the need of the hour that the aforesaid National Policy is followed in letter and spirit and any water is not diverted outside the basin. The witness has stated that prioritization of meeting the demands, should be as per the National Water Policy 2012 and if demand is more than the available water, one may have to drop some of the Hydro-power schemes.

358. It was brought to the notice of the witness that in his affidavit dated 14.11.2017, he has mentioned about adverse

impact of, diversion of water by the States of Karnataka and Maharashtra from Mahadayi basin on different aspects, such as, tourism, navigation, flora & fauna, waterfalls, environment, salinity etc. in the State of Goa, but it is not found by the Tribunal if there is any mention about the likely impact of such diversion on the flora & fauna, forest and wild life etc. in the Karnataka as well as Maharashtra territory of Mahadayi basin is made. Therefore, the witness was called upon to indicate whether these aspects were examined by him, and if so, what were his observations.

In reply, the witness has stated that, the adverse effect of diversion of water by Karnataka and Maharashtra in their respective territories would also be drastic. According to the witness Karnataka has proposed diversion in and around the Wildlife Sanctuaries, not only in Goa, but also in Karnataka and a lot of forest area will, not only be inundated, along with other areas, but the pumping from Kotni Dam of 7 tmc, with pumps of HP of more than 5000, will not only damage the whole environment but also change the climate in the region, as a huge consumption of energy is envisaged in the area. The witness has further mentioned that in Maharashtra also, there would be definitely an adverse effect on the environment and further in the case of Karnataka diversion, however, there would be a cascading damaging effect on the Wildlife Sanctuaries in Goa too as they are contiguous and environment does not follow the State boundaries.

359. The witness was informed that it is noticed by the Tribunal that his Affidavit dated 14.11.2017 includes the demand for various sub-basins but the witness has not indicated the names of the identified projects/claims for meeting the identified demands as was done by the Panel of Experts, constituted by the State of Goa. It was further pointed out to the witness that the Tribunal was feeling that the identification of projects/schemes was necessary because, only then, it would be possible to assess the "utilizable water" out of the "available water". The witness was called upon to inform especially about the names of the various projects/schemes identified by him and the quantum of utilizable water, through such projects/schemes.

The witness, in answer has stated that the State of Goa intends to meet the demands for major uses through the 61 projects identified by the Panel of Experts, however, in case of some of the demands, it is not possible to prepare the DPRs, such as environment demands, tourism demands etc., but attempts are being made to identify more projects, especially like abandoned mining pits, construction of bandharas etc. for fulfilling the demands.

360. The attention of the witness was drawn to what he has stated in para 23 on pages 43 and 44 of Annexure II of his affidavit dated 14.11.2017 and it was brought to his notice that although he has stated that the "evapo-transpiration will increase, and losses by direct evaporation from water bodies, reservoirs, canal surfaces and farms will also increase, he has chosen, not to account for such likely increases. Therefore, it was put to the witness that is it not a case of faulty planning and how Goa intends to meet the future challenges which have been duly flagged by him.

In answer, the witness has stated that it is a fact that global warming will result in increase in temperatures, which, in turn, will increase the evaporation losses and also the crop-water requirements. The witness has mentioned that the issue was discussed at Government Department level and since water saving measures would be implemented, the irrigation requirements are kept in line with the Master Plan prepared by Panel of Experts. The witness has further stated that this is not a case of faulty planning and that the State plans to provide for micro-irrigation and water saving techniques to counter for the global warming. The witness has also stated that crop-water requirement will definitely increase due to global warming, however, because of the above measures envisaged, the irrigation demands would be met.

361. The attention of the witness was drawn to what he has stated in para 23 on pages 43 and 44 of Annexure II of his affidavit dated 14.11.2017, and with regard to the facts mentioned in the said para a question was put as to what are the likely impacts of global warming and climate change on water availability of Mahadayi basin and the quantity of likely increase or decrease in the waters of Mahadayi basin, say by 2050 AD. A question was further put to the witness as to what is the estimated quantity of losses due to increase in evapotransportation, direct evaporation from water bodies, reservoirs, canal surfaces and farms, etc.

The witness, in answer has mentioned that though there would be impact of global warming on the water availability in the Mahadyi basin, the State of Goa has not estimated the same. The witness has further stated that the estimated quantity of losses in each project, due to increase in evapo-transpiration, direct evaporation from water bodies, reservoirs, canal surfaces and farms etc. has also not been estimated.

362. The attention of the witness was drawn to what is stated by him in para 6 on pages 29 and 30 of Annexure II of his affidavit dated 14.11.2017 and a question was put as to why assessment of sub-basin wise water availability and water demands, instead of assessment of project wise water availability and water demand, are considered necessary. Another question which was put to the witness was as to would such approach to the basin planning viz., restricting the planning of sub-basin, not put severe restrictions in planning for optimal utilization of water resources of Mahadayi basin.

The response of the witness was that the aim of his study was to find out the water demands in each sub basins vis-à-vis, the availability of water and to ascertain whether any water was surplus/deficient sub-basin wise, as well as for the whole basin. It was mentioned by the witness that projects are planned as per the availability of water. The witness has further stated that restricting the planning to sub basin, in his opinion, shall not put severe restrictions in planning for optimal utilization of water resources in Mahadayi basin.

363. The witness was requested to refer to table 12 on page 64 of Annexure II of his affidavit dated 14.11.2017, and it was pointed out that the Tribunal did not find any mention about the water needs for Hydro-power development in the State of Goa. Therefore, the witness was called upon to indicate the details of water requirement of Goa for Hydro-power development, if any, in this regard.

In answer, the witness has stated that he has not mentioned the water requirements of Goa for Hydro-power development in his study, but he wishes to rely upon para 18D (i) of the Amended Statement of Claim of the State of Goa (Volume-131), and also the Master Plan prepared by the Panel of Experts of the State and he has mentioned that he reiterated the same. According to the witness the requirement for Hydro-power is 28.137 tmc.

364. The witness was asked a question as to whether he had undertaken any in-depth scientific evaluation of the issue of prioritization of various uses of water with due consideration of social, economic and environmental aspects and particularly in the context of prioritization among in-basin uses and utilization through extra basin diversion and if such in-depth scientific evaluation has been undertaken, what are the findings thereof.

The witness has mentioned in the answer that the in-depth scientific evaluation of prioritization has not been undertaken by him but the prioritization would be followed as per the National Water Policy 2012, or any other policy in force at the relevant time.

This is the sum and substance of the evidence of Shri Subrai T. Nadkarni, AW5.

Oral Evidence of RW-3 Shri S.M. Jamdar for the State of Karnataka

365. The Tribunal has already discussed the evidence of witnesses, produced by the State of Goa, and now it proposes to discuss the evidence led by Shri S.M. Jamdar, RW-3, examined on behalf of the State of Karnataka, who has deposed on three questions, namely:-

i) Whether the Taluks of Bailahongal, Ramdurg and Saundatti of Belagavoi district, Badami Taluk of Bagalkot district and Ron taluk of Gadag district, are drought prone areas?

ii) Whether by transfer of 5.527 tmc of Mahadayi water to Kali Hydro Electric Project, more power can be generated on the existing infrastructure?

iii) Whether the Mahadayi Hydro-power Project (Kotni HEP), which is non-consumptive, is feasible for augmenting the power to meet the peak demand in Karnataka?

366. His Examination-in-Chief was recorded by the Tribunal on 29.11.2017 and he has stated that he had sworn his affidavit on 0.11.2017 and filed the same before the Tribunal on 14.11.2017 as evidence, which be treated as his Examination-in-Chief. He had identified his signatures on the aforesaid affidavit. Along with the affidavit, the witness had appended three documents which were taken on record and marked as MARK-KA/29, MARK-KA/30 and MARK-KA/31(Colly.).

367. In para 1 and 2 of his affidavit, the witness has mentioned about his educational qualifications, expertise, experience and job profile. The witness has stated that the Govt. of Karnataka had requested him to depose before the Tribunal and that he had accepted the said request after going through the pleadings and materials on record. In para 5 of his affidavit, the witness has stated that three Taluks of Belagavi district viz. Saundatti, Bailahongal and Ramdurg and one Taluk, namely Badami of Bagalkot District and one Taluk i.e. Ron of Gadag District in Malprabha command area, are drought prone, posing serious challenge for meeting agriculture and drinking water needs. The witness has stated that the Govt. of India, based on the report of Prof. Hanumantha Rao Committee has identified Taluks in Desert Development Programme (DDP) and Drought Prone Area Programme (DPAP) and one Taluk namely Badami is covered under DDP, whereas the three Taluks of Belagavi District, namely Bailahongal, Ramdurg and Saundatti and Ron Taluk of Gadag District, are classified as DPAP. In para 6 of his affidavit, the witness has reproduced Table, which demonstrates the DPAP/DDP area and the area coming under irrigation by surface water. The said Table reads as under:-

Area in Hectares

SI. No.	Taluk	Culturable area and Geographical area for the year 2012-13	Area under DPAP	Area under DDP	Area under Mala- prabha comm- and	Area under other major and medium projects	Area under M.I. Tanks	Balance Un- irrigated area
1	2	3	4	5	6	7	8	9
1	Bailhongal	89615	112200	Nil	7667	-	457	81491
		112233						(90.9%)
2	Saundatti	123811	158000	Nil	36083	-	-	8778
		158146						(70.8%)
3	Ramdurg	96101	114000	Nil	18164	-	146	77791
		121542						(81.0%)
4	Badami	93940	Nil	Whole	28565	-	-	65735
		139420		Taluk				(69.6%)
5	Ron	120941	128600	Nil	34268	-	-	86673
		129091						(71.7%)

368. In para 7 the witness has referred to the chart of rainfall data of Malaprabha basin for 47 years, as prepared by the Karnataka State Natural Disaster Management Centre and has annexed the same, to his affidavit, as Annexure-1. According to the witness, the chart shows that almost two, in every four years, witnesses failure of or inadequate Southwest Monsoon rains, which leads to drought. The witness has further stated that sometimes, drought continues for consecutive two to three years, which creates worst situation for any Government to handle. The chart of various Taluks declared as drought affected by the Govt. of Karnataka at Malaprabha Basin from 2001 to 2016, is annexed by the witness as Annexure-2 to his affidavit. According to the witness Malaprabha is designed to provide irrigation, largely to the drought prone areas, but the actual yield of water into the Malaprabha reservoir has been deficit by 17 tmc and as against designed intake of 44 tmc, on an average, about 27 tmc of water, is actually reaching the reservoir. What is claimed by the witness is that, it is necessary to augment the water availability by diverting Mahadayi water to Malaprabha Project and the witness has reproduced a Table which provides the details of the irrigation command of Malaprabha Project in DPAP and DDP Taluks, which reads as under:

"SI.	District and Taluks	Ultimate Irrigation
No.		Potential (in Hect.)
I	Belagavi District Taluks	
	1) Bailhongal	7667
	2) Ramdurg	18164
	3) Saundatti	36083
	Total of Belagavi District	61914
П	Bagalkot District	
	1) Badami	28565
Ш	Dharwad District	
	1) Navalgund (Non-DPAP)	38552
	2) Hubli	4382
	Total of Dharwad District	42934
IV	Gadag District	
	1) Nargund (Non-DPAP)	27761
	2) Ron	34268
	3) Gadag	690
	Total of Gadag District	62719
	Grand Total	196132"

369. The witness has further stated that, the existing ten Lift Irrigation Schemes in the foreshore areas of the reservoir, cater

to irrigate some of the DPAP areas in Bailhongal and Saundatti Taluks which were also the areas where project displaced families have been relocated. The witness mentions that the total area irrigated by these ten Lifts Irrigation Projects is 26,971 Hectares as per the Modified Detailed Project Report of the Malaprabha Project.

370. In para 10 of his affidavit, the witness has again drawn a Table, which according to him indicates the meager rainfall and had negative deviation. The Table reads as under:-

SI No	Taluk	2003		2004		
		R.F. (mm)	% deviation	R.F. (mm)	% deviation	
1.	Bailhongal	375.6	(-)61	565.6	(-)41	
2.	Ramdurg	316.1	(-)44	651.8	(+)16	
3.	Saundatti	325.0	(-)48	487.7	(-)22	
4.	Ron	401.3	(-)40	690.5	(+)4	
5.	Badami	315.3	(-)49	724.1	(+)17	

371. The witness has further proceeded to state that, the inflow into Malaprabha reservoir in 2003-04 and 2004-05 was 16.25 tmc and 24.25 tmc respectively as against the average inflow of 36 tmc. The witness has stated that the successive years of drought had resulted in unrest among the farmers and people

of these Taluks were on the verge of creating law and order problems. According to the witness, the rainfall deficiency gave rise to critical drinking water crises and the Government issued necessary orders for remission of payment of revenues by the farmers and the loans payable by the farmer were re-scheduled by the Banks on the intervention of the Government. The witness has mentioned that the Central Assistance to the extent of Rs.1148 crores was also sought for drought relief measures in the Karnataka State, out of which only Rs.84 crores were sanctioned by the Central Government. According to the witness, the plea of the State of Karnataka for transfer of 7 tmc of water to Malaprabha reservoir from surplus water at Kotni Dam for providing protective irrigation, drinking water needs, etc. will go a long way in mitigating hardship caused to the inhabitants in drought prone areas in Malaprabha basin. The witness has proceeded to state that Hydropower is renewable, non-polluting and environmental friendly source of energy. The witness has referred to the National Electricity Policy announced by the Government in February, 2005 and has stated that the said policy has identified the hydro generation as a thrust area for development and the preferred source of power, particularly in the context of rising fuel cost. The witness has mentioned that the hydro power generation is the highly capital intensive, but being a renewable source of energy with no involved consumables, there is very little recurring cost and hence no long term expenditure.

372. In para 16 of his affidavit, the witness has mentioned that generation of power in the State is not matching with the accelerated demand for power from industrial sector and has pointed out that the annual peak demand in the year 2011-12 was 12176 MW, whereas the supply was only 8401 MW. The witness has stated that the unrestricted demand for energy in the State in the year 2012-13, up to December 2012 was 4839 Mu; whereas the actual supply was 41958 Mu, leaving a deficit of 6391 Mu. The witness has mentioned in his affidavit that Karnataka State, at present, has an installed capacity of 9912 MW and at present there is severe shortage of power, which has necessitated power cuts to the order of 50% on H.T. consumers and even L.T. consumers are not spared from the scheduled and unscheduled power cuts. After referring to the location of Mahadayi and Kali basins in Western Ghats, it is emphasized that the diversion of water from these projects to the existing Supa reservoir will augment the storage of water in Kali basin, which will help increased generation and also for generation during peak hours by utilizing the high installed capacities in the basin.

373. The witness has mentioned that the State of Karnataka has proposed diversion of 5.527 tmc of water from Mahadayi water to Kali reservoir basin for augmenting the power generation at Kali Hydro Electric Project and among the southern States, the power project in Karnataka has been in shortage. The witness has informed the Tribunal in his affidavit that the shortage is being made up, annually, by drawing power from the Grid and purchases from the neighboring States, including the State of Maharashtra.

374. The witness has stated that under KHEP, a huge dam known as Supa Dam across the river Kali was constructed with a capacity of 147.54 tmc and live capacity of 132.71 tmc, but the yield release is 94.74 tmc and in 28 years, the Kali dam filled up only twice, as a result of shortage in inflows. According to the witness, the State has not been able to operate and generate the full installed capacity of power in Kali project. The witness has maintained that the State of Karnataka, has therefore, proposed a diversion of 5.527 tmc of Mahadayi water to Kali and if this water is diverted, it will generate about 182 Mu power from the existing infrastructure at KHEP.

375. The witness has mentioned that State of Karnataka has proposed Mahadayi Hydro-power Project at Kotni, across Mahadayi river which is non-consumptive in character with installed capacity of 200 MW and to generate 337.73 MU of energy. The witness mentions that the energy generated would contribute to meet the much needed peak demand, and since this Project, does not consume any water, except for evaporation losses of about 0.40 tmc, it would not adversely affect the downstream interests.

376. This witness was Cross-examined by the learned Counsel for the State of Goa and certain questions were also put to the witness by the Tribunal. Having regard to the facts of the case, the Tribunal proposes to discuss only those questions and answers, which are found to be relevant. The attention of the witness was drawn to para 12 at page 12 and para 13 of his affidavit dated 9.11.2017 by the learned Cross-examiner, on behalf of the State of Goa. It was noticed by the learned Crossexaminer, for the State of Goa, that while making a statement in the above mentioned paras, the witness had not taken into consideration the environmental impacts of stoppage of water, diversion, the construction works including the river diversion works, etc., and therefore, it was put to the witness that the statement made by him in paras 12 and 13, which were quoted in question No.7 are without any basis whatsoever and without conducting any study to that effect.

The response of the witness was that he was not an expert in hydrology and power engineering, by way of having any professional degree or education and training, but he had worked as a Managing Director of Karnataka Power Corporation Ltd., for about three years, which constructed, and today owns and operates nearly 40000 MW of hydel power, in environmentally most difficult area and that the State of Karnataka is aware of the environmental issues and had considered them. The witness further stated that the State of Karnataka will be able to take care of those issues, as and when situation arises, with the relevant authorities in the Government.

377. After the cross-examination by Shri Dattaprasad Lawande, the learned Advocate General for the State of Goa was

over, Shri Lawande had stated that he had no further questions to ask this witness in his cross-examination and as such he had closed his cross-examination, and therefore, Shri D.M. Nargolkar, the learned Counsel for the State of Maharashtra was requested to cross-examine the witness, but Shri Nargolkar had stated that he did not want to cross-examine this witness. Therefore, certain questions were put to the witness by the Tribunal.

378. The attention of the witness was drawn to what he had stated in para 8 at page 8 of his affidavit and a question was put as to how he had arrived at the conclusion that "it is necessary to augment the water availability by diverting Mahadayi water to Malaprabha Project" before examining all issues, particularly reliability of the assessment of water availability of river Mahadayi at different locations and its tributaries vis-à-vis water requirements for various purposes in Mahadayi basin. The Tribunal had further noticed that it was apparent from the statement made by the witness that Malaprabha Project is designed to provide irrigation to the drought prone areas and the suggestion of the witness for augmenting the water availability by diverting Mahadayi water is aimed to overcome the shortfall in irrigation to drought prone area. Therefore, a question was put to the witness as to whether he had examined all other possible alternatives for overcoming the shortfall in irrigation water needs in drought prone areas, viz. the possibility of demand side management, such as, use of micro-irrigation, appropriate choice of cropping pattern, etc.

In answer, the witness stated that he was not in a position to comment on the reliability of assessment of water availability in the river Mahadayi at different locations and its tributaries, visà-vis water requirement for various purposes, since he was not technically competent to do so. The witness further stated that he presumed that the technical experts must have done the assessment using their due diligence, basing their conclusions, on the relevant technical parameters, and hence he believed that the aforesaid assessment was correct.

379. The witness further stated that the State of Karnataka has made the huge investments in the development of irrigation command such as canals, distributaries, FIC, land levelling, etc., which is going waste in view of the deficiency observed in later years and this factor was also taken into account. The witness has further stated that the M&G CADA did make efforts to salvage the situation by way of resorting to water saving measures such as drip irrigation, sprinkler irrigation, re-cycling of the drainage water and the like and yet the deficient situation does continue to a considerable extent. The witness stated that other than diverting water from the upper basin like Mahadayi, there does not seem to be any more viable way of augmenting the water. The witness added that Mahadayi basin water to the extent of the quantity of water that is generated within the boundary of Karanataka, not only is flowing into the State of Goa, but also is not being at the present harnessed by the basin States, and therefore, he felt that it is necessary to augment the deficiency found in the Malaprabha basin by way of diverting some quantity of water that would be available from Mahadayi basin to salvage the situation as much as possible.

380. The pointed attention of the witness was drawn to paras 11 and 12 of his affidavit and the statements made by the witness therein were brought to his notice. The Tribunal was of the view that the drinking water supply must be planned from highly reliable sources, which have availability of water at 100% dependability. Therefore, a question was put as to how can the 100% dependability be ensured through the surplus water at Kotni dam, which would generally be available only in those years when actual rainfall is more than the average rainfall.

381. The Tribunal had further noticed that the surplus water cannot be considered to be available in each year and particularly during the drought years when there would be no surplus at all, and therefore, it may not be appropriate to assume that the plan to transfer such surplus water will help in mitigating the hardship to the inhabitants during drought periods. Therefore, a question was put to the witness, as to whether he had examined all these aspects, and how such measures would help providing protection to irrigation and mitigating the hardship of the inhabitants of drought prone areas during the drought period.

In response, the witness stated that the diversion of Kotni Dam water was not intended for drinking water supply and it was basically for power generation and protective irrigation in the drought prone areas. According to the witness the word appearing in his affidavit drinking water was a mistake and he apologized for the same. The witness further stated that during the drought years, definitely there may be deficiency in flow at Kotni Dam and consequently, deficiency in the quantity of water to be diverted for protective irrigation in the Malaprabha Project, but that kind of risk has to be taken and at least in the years whatever quantity of water is available, that will be useful.

This is sum and substance of the evidence of Shri S.M. Jamdar (RW-3).

Oral Evidence of RW-4 Shri G.M. Madegowda for the State of Karnataka

382. Having discussed the testimony of Shri S.M. Jamdar, RW3 examined by the State of Karnataka, the Tribunal now proposes to discuss the evidence of RW4 Shri G.M. Madegowda an expert witness examined on behalf of the State of Karnataka on the drinking water demand of Hubli-Dharwad en-route villages, etc., from Malaprabha reservoir.

The witness has tendered his affidavit dated 9.11.2017 on 14.11.2017 (Volume 207). The Examination-in-Chief of the witness was recorded on 29.11.2017. After tendering his affidavit dated 9.11.2017 before the Tribunal, the witness has verified his signatures on the affidavit and has reiterated the contents of his
affidavit. Along with his affidavit, he has filed Annexures 1 to 6 which were taken on record, by the Tribunal.

In paragraph 2 of his affidavit dated 9.11.2017, the 383. witness has given details about his educational qualifications, expertise, experience and job profile. The witness has mentioned that "Report on the Drinking Water Demand of Hubli-Dharwad en route villages, etc., from Malaprabha reservoir was prepared under his authority as the Chief Engineer, North Zone Dharwad. The witness has stated that in November 2012, the said report was submitted to the Chief Engineer, WRDO, Bangalore and subsequently the report was filed before the Tribunal on 2.1.2013 which is exhibited as Exhibit No. KAR-67 (Volume 16). According to the witness, the old sources of water supply to Hubli-Dharwad were, Unkal and Kelageri tanks of the storage capacity of 2.27 Mcum (0.08 tmc) and 1.70 Mcum (0.06 tmc) respectively. The witness has stated that Kelageri was abandoned long ago whereas Unkal was abandoned in 1996. According to the witness the first stage water supply system from Neerasagar reservoir, was commissioned in 1955 and had a capacity of 6.50 Mcum/year (0.229 tmc/year) and later in the second-stage, it was augmented to 14.47 Mcum/year (0.51 tmc/year) in the year

1969, but the Neerasagar reservoir of the storage capacity of 1.02 tmc is not reliable source as it rarely fills up as is evident from the extracts of the log books. The witness has mentioned that the Government of Karnataka, in an effort to find a dependable source for providing emergent relief to the inhabitants of Hubli-Dharwad, identified the readily available Malaprabha storage in 1981. The witness has informed that Malaprabha source was developed in two stages and in the first stage namely "Malaprabha Water Supply Scheme to Hubli-Dharwad Municipal Corporation", 34 MLD was planned in 1983 and in the second stage namely "Malaprabha Water Supply Scheme to Hubli-Dharwad" the drawl from the Malaprabha was increased to 68 MLD in 1983 but subsequently due to aging and maintenance problems and also to improve the energy efficiency, these two schemes were stopped and a new bulk water supply system head-works to Water Treatment Plant of the capacity of 73.80 MLD was planned under the scheme "Emergency Improvement to Water Supply System to Hubli-Dharwad city" which was commissioned during 2004. The witness has mentioned that due to the increase in population and also due to uncertainty of filling up of Neerasagar reservoir, bulk water supply improvements, were taken up from Malaprabha reservoir during 2011 under the scheme namely "Bulk Water Supply Improvement to Hubli-Dharwad Twin City with Malaprabha reservoir as source" and in this scheme drawl of another 80 MLD water was planned and implemented and thus the total water drawls from Malaprabha Dam as in 2011 was 153.80 MLD (1.98 tmc), for meeting the drinking water requirements of Hubli-Dharwad en route villages and Kundagol Town. In paragraph 7 of his testimony the witness has stated that the total projected demand, from the Malaprabha Dam for these areas i.e. Hubli-Dharwad en route villages and Kundagol Town, has been estimated as 7.65 tmc by 2044. In paragraph 8 of his affidavit the witness has mentioned about a detailed energy audit, reported by Tata Energy Research Institute during 2002 and detailed energy audit, conducted and reported by Tata Energy Research Institute, has been annexed as Annexure-I with his affidavit. In paragraph 9 of his affidavit, the witness has referred to report submitted by "Bristol Water Services Austria GmbH as Annexure-2 to his affidavit and has proceeded to state that based on the above study, improvement to bulk water supply and distribution system are progressively taken up. The list of various measures, undertaken by the government agencies for improvement of bulk water supply and distribution system of Hubli-Dharwad, is

produced by the witness as Annexure-3 with his affidavit. The witness maintains that due to the above projects, about 1/3 population of Hubli-Dharwad city of 3,21,000 is now supplied water with continuous pressurized water supply system and in order to extend continuous pressurized water supply system, to the entire city and to improve bulk water supply system, a detailed project report has been prepared by Tata Consulting Engineers and the recommendations made by Tata Consulting Engineers, are reproduced by the witness on page 9 of his According to the witness, the Government has affidavit. approved "Karnataka Urban Water Sector Improvement Project Upscaling 24x7 continuous Water Supply to cover entire corporation of Hubli-Dharwad" at an estimated cost of Rs.1,14,600 lakhs and the work under the project is in progress through Karnataka Urban Infrastructure Development and Financial Corporation, which on completion, would provide infrastructure for 24x7 continuous water supply of 5.20 tmc drawn from Malaprabha Dam.

384. In Paragraph 13 of his affidavit the witness has dealt with alternative sources for Hubli-Dharwad en route villages, etc., and has stated that Malaprabha source, was identified, because of its proximity to Hubli-Dharwad and also because of availability of source storage and also as per the instructions of the Government. What is mentioned by the witness is that water supply from Almatti Dam, Supa Dam, Tungbhadra Dam and Bedti River were techno economically not feasible as revealed in the "Report on Drinking water demand of Hubli-Dharwad en route villages etc. from Malaprabha reservoir" filed 02.01.2013 (page 23, Volume 15). According to the witness ever since the project for drawl of water from Malaprabha dam was commenced, there have been conflicts between irrigation demand and drinking water supply, more particularly during summer months, as water level in the dam would fall so low, from February to June, that drawl of water for drinking water supply would become contentious between City Corporation and the farmers. The witness informs the Tribunal that the farmers of Malaprabha Cultural command. farmer organization Kannada and Organizations would resort to protest whereas the general public of the city, have resorted to dharnas, bandhs, strikes, disrupting the public transport system, etc. which has resulted in drinking water supply getting disrupted. According to witness, the newspaper clippings reveal that demonstrations, dharnas, hunger strike, sit-ins, and city bandhs, occasionally even leading to the stoppage of pumping system and water treatment plants, have been resorted to by the farmers against the drawl of water from the dam. The witness proceeds to state that this is the situation in regard to the existing drawl of about 1.98 tmc and therefore, it is imperative to augment the Malaprabha dam by diversion of Mahadayi waters to the extent of 7.56 tmc, to provide sustainable drinking water supply to Hubli-Dharwad en route villages, etc., and once the Mahadayi diversion takes place, the Malaprabha water drawn from the Malaprabha dam can be restored for utilization by farmers etc. in Malaprabha command area.

385. According to the witness, the population of Hubli-Dharwad twin city as on 1901 was 81,143 and as on 2011, it was 9,43,857 whereas the population of Kundgol town and en route villages as on 2011, is 18,719 and 1,01,838 respectively, and the projected population of Hubli-Dharwad twin cities en route villages and Kundgol town are worked out, based on the Central Public Health & Environmental Engineering Organisation manual of the Ministry of Urban Development, Government of India on water supply and treatment in the year 1999. The witness has produced the said manual as Annexure-6 with his affidavit. As per Annexure-6 the population figures indicated from 1981 up to 2051 is as under: MARK-KA/36 which is to be found on page 264 and 265. The witness further states that the State Government has improved the water supply infrastructure and at present the works undertaken would ensure supply of 5.20 tmc ft of water on 24x7 basis if Malaprabha dam is augmented by Mahadayi waters, to the extent of 7.56 tmc.

386. The witness was cross examined by the learned Counsel Shri Duttaprasad Lawande, learned Advocate General for the State of Goa and several questions were put to the witness. The Tribunal had also put certain questions to the witness, to elicit better information regarding the drinking problem existing in Hubli-Dharwad twin cities. In question No.1, the attention of the witness was drawn to para 4 on page 3 of his affidavit dated 9.11.2017 and a question was put to the witness that the documents mentioned in the question did not form part of the report at Volume No.16 whereas those documents were prepared subsequently, tailor-made to suit the report and inserted in the report, before it was submitted to the Tribunal, and the response of the witness was therefore, sought on the point that the report titled as "Report on Drinking Water Demand of Hubli-Dharwad, En-route villages, etc. from Malaprabha reservoir" at Volume 16, was only unreliable and untrustworthy and could not be relied upon. In answer, the witness admitted that there as an apparent mistake in para 5 at page 3 of his affidavit and in fact the correct month in which his report was submitted to the Chief Engineer WRDO Bangalore was December 2012. Having offered the above stated explanation the witness expressed his apologies for the mistake and stated that suggestion given in the question did not subsist in view of his explanation.

387. Again in question No.2, a suggestion was put to the witness that it was apparent from the cover page of the said report at Volume No. 16 that the report was prepared in November, 2012 itself and therefore the said report was wholly unreliable and untrustworthy.

In answer to the said suggestion the witness stated that the report was prepared by his subordinate Executive Engineer in November 2012 and he had verified the same during the month of December 2012. According to the witness he had a discussion with his subordinate Engineer and a number of corrections were made in the office of the Chief Engineer and finally it was submitted to the Chief Engineer, WRDO Bangalore in the month of December 2012. The witness added that at the time of finalization of the report, in the office of the Chief Engineer, certain documents were appended to the Report, which were dated later than the preparation of the report by the Executive Engineers. The witness further stated as under:

"... It appears that the Report which was finalized in the month of December, 2012, and was so submitted to the Chief Engineer, WRDO, Bangalore in December, 2012, was through an inadvertence, still titled as that of November, 2012. The aforesaid Report was, finally, submitted by the State of Karnataka before this Hon'ble Tribunal on 02.01.2013".

388. In question No. 5, it was mentioned to the witness that water required for population of twin cities of Hubli and Dharwad, as per census of 2011 as provided by the witness in Annexure-6, would work out to 1.64 TMC only, considering that the total population as on 2011 is 9,43,857 and recommended maximum per capita supply is 135 litres per day. Having so mentioned, the response of the witness was sought by the learned Cross Examiner on behalf of the State of Goa.

The witness responded by stating that the domestic requirements of Hubli-Dharwad will be 135 LPCD i.e. litres per capita +15% for Unaccounted for Water as per note (ii) of Table 2.1, and further the institutional needs of the water shall also have to be taken into consideration. guestion No.7 put to the witness indicates that based on the information available from data at MARK-GOA/38, the State of Goa had prepared a chart titled "Calculation of Yield at Neerasagar reservoir" copy of which was handed over to the witness and it was pointed out to him that there should be no difficulty, in regular filling of Neerasagar reservoir of Bedti river which is a west flowing river and therefore the statement made by the witness that reservoir fills rarely which allegedly is based on extracts from log books was incorrect and that not only the reservoir should fill up regularly but there would be surplus water available in Neerasagar reservoir catchment, than the capacity of the reservoir. Having drawn the attention of the witness, as mentioned above, the response of the witness was sought. The witness stated that he had made the statement in the affidavit on the basis of log books recordings, maintained by the Karnataka Urban Water Supply and Drainage Board, however, the said log books are not available with him

and that since the Neerasagar reservoir does not regularly till up to its capacity, the question of any surplus water does not arise.

389. After the cross examination of the witness by the learned Counsel for the State of Goa was over, a statement was made by Shri Dattaparasad Lawande, the learned Advocate General of Goa that he has no further question to ask the witness in his cross examination and as such he has closed his cross examination. Thereafter Shri D.M. Nargolakar, the learned Counsel for the State of Maharashtra was requested to cross-examine the witness but Shri Nargolkar has stated that cross examination of this witness by him was not necessary. Therefore, the Tribunal has put certain questions to the witness.

390. In question No. 3, the attention of the witness was drawn to para 11 on page 9-10 of his affidavit dated 9.11.2017 and the witness was called upon to state as to why "Karnataka Urban Water Sector Improvement Project Upscaling 24x7 continuous water supply to cover the entire corporation of Hubli-Dharwad" has been planned for 5.2 tmc and how a project can be approved and work on the same started by the State Government with a river subject to allocation by this Hon'ble Tribunal and why the scheme has been prepared and approved without identifying reliable and confirmed sources of water.

The response of the witness was that it is planned to provide an assured and pressurized continuous water supply to Hubli-Dharwad Corporation area to a projected population of the year 2041 and the 5.2 tmc of water required for that purpose has by the Consultants of Karnataka Urban been planned Infrastructure Development Finance Corporation. According to the witness, decision to approve the project and to start work on the project was taken by the State Government of Karnataka as a policy decision. The witness further stated that it is the existing source where the Municipal Corporation is already drawing 1.98 tmc per year and the future planning has been done in anticipation of this Tribunal allotting water to the State of Karnataka.

391. In question No.7, the attention of the witness was drawn to the statement made in para 16 on page 14 of his affidavit dated 9.11.2017 and a question was put to the witness as to why the year 2044 AD has been chosen for assessing the future projection of water requirement and why the projection is not made for commonly used period, say, up to 2050 AD or 2051 AD etc. and why augmentation of full projected requirements of water from new sources has been considered necessary and why quantum of water already available from the existing sources has not been taken into consideration, while assessing the requirement of water from new sources. Yet other questions which were put to the witness, were as to what precisely he meant, by the statement "relieve the burden on the existing water of Malaprabha dam which is required for meeting the requirements of command areas, etc." and did he consider water needs for drinking water supply of Hubli-Dharwad twin cities, which has a highest priority, as a burden.

In answer, the witness mentioned that the year 2044 has been chosen for assessing the future projections since the period of three years is taken for implementation of the project and therefore, from 2041 the year 2044 was selected. The witness mentioned that earlier sources which were existing, were not providing sufficient quantity of water any more and therefore the water from new source was sought to be tapped but whatever water is available from the existing source i.e. the Neerasagar reservoir is also being taken for the purpose of planning. According to the witness, the drinking water supply of Hubli-Dharwad twin cities cannot, in any manner be considered as a burden.

392. In question No.8, the attention of the witness was drawn to Table 3 on page 11 of Annexure 61 which is "Report on Drinking water demand of Hubli-Dharwad en route villages, etc., from Malaprabha reservoir (Volume 16) and it was brought to the notice of the witness that it is noticed by the Tribunal that domestic water demand has been estimated for the years 2011, 2021, 2031, 2041, 2051 and then for 2044 but subsequent Tables i.e. Table 3.1 Table 3.1.1 and Table 3.2 whose data are used for finalization of Table No.3, do not include figures for 2044. Having drawn the attention of the witness to the above mentioned inconsistency, it was put to the witness as to why the water requirement figures for the year 2044 AD have been indicated only in Table No.3 and how the figures corresponding to 2044 AD have been arrived at.

The response of the witness was that he had arrived at the population projection for the year 2041 and 2051 and then he had interpolated between these two years and arrived at the figures corresponding to the year 2044 AD and the requirement of 2044 AD gets reduced and the 7.56 TMC corresponds to the year 2046 AD and to that extent he stands corrected.

393. In question No.9, the witness was confronted with a titled "India: North Karnataka document Urban Sector Investment Program (Tranche 2) – Hubli-Dharwad" prepared by Karnataka Urban Infrastructure Development Finance Corporation for the Government of Karnataka which was downloaded from the internet and his attention was drawn to what is stated in para 49 of the said document. Having drawn the attention of the witness to the relevant part of the said document, a question was put to the witness as to why and how such huge amount i.e. 40% of the water supply by the water supply network is being allowed to be wasted through leaks into the ground and it was put to the witness that with measures to avoid such wastage, the quantum of water required from new sources can be considerably reduced and a question was put as to why this aspect has not been considered, while assessing the water requirement from new sources and what measures are being taken to avoid such huge wastage of water leaking into the ground.

The answer of the witness was that the water distribution and pipelines had been laid very long back and the joints are leaking whereas the pipes are also aged and incrusted, corroded and as such they are subject to leakage. The witness mentioned that the Government of Karnataka, fully knowing this issue, is making all efforts to reduce the water supply losses to the presumable limits by investing huge amount and the replacement of defective pipes completely is being envisaged. The witness, unequivocally stated that already about 1/3 of the population is covered with 24x7 water supply and as such the leakage has been reduced considerably. The witness mentioned that the necessary measures have been taken and also continued to be taken up to reduce the water losses and the above aspect has been considered while assessing the water requirement of the population at 135 LPCD, with 50% unaccounted for water. The witness also stated that after the preventive measures are taken and completed, 25% of additional water would be available for distribution to general public but the same would be within the stipulated limits.

This is the sum and substance of the evidence of Shri G.M. Madegowda, RW-3.

Oral Evidence of MW-2 Shri B.C. Kunjir for the State of Maharashtra

394. Having discussed the evidence of witnesses examined by the State of Karnataka, now the Tribunal proposes to discuss the evidence of Shri B.C. Kunjir, who was examined by the State of Maharastra as MW-2, on 1.12.2017. In his Examination-in-Chief, the witness has tendered an Affidavit dated 27.10.2017, (Volume 205) sworn by him, and which was produced before the Tribunal on 14.11.2017. The witness had filed four documents along with the Affidavit, which were ordered to be taken on record. In Para 1.0 of his Affidavit dated 27.10.2017 (Volume 205), in Point 1.0 to 1.5, the witness has mentioned about his educational qualifications, expertise, job profile etc. In Paragraph 2.1 the witness has mentioned needs of the State of Maharashtra as projected in Para 6.0 (6.5) on Page 3 of its Master Plan [Volume 52(D)], as under:

"1.For irrigation (in basin for 4600 Ha)55.0 Mcum2.Drinking Purpose (in basin)5.0 Mcum

3.	Hydro Power Generation	15.0 Mcum
4.	For Industrial	25.0 Mcum
5.	For Irrigation in Tillari Basin	80.0 Mcum
	Total :	180.0 Mcum"

395. He has further stated that the State of Maharashtra has projected the following needs in its Statement of Case (Volume 27), Para 3.5.2, Page 25:-

	Say	-	180.00 Mm ³ "
	Grand Total	-	179.32 Mm ³
7)	Evaporation losses 10 %	-	16.30 Mm ³
	development		
6)	Provision for future	-	25.00 Mm ³
	of Tilari basin		
	adjoining uncommanded area		
5)	Industrial water needs in	-	1.10 Mm ³
	of Mandovi river basin		
4)	Industrial water needs in part	-	1.00 Mm ³
	of Tilari basin		
	adjoining uncommanded area		
3)	Drinking water needs in	-	2.00 Mm ³
	of Mandovi river basin		
2)	Drinking water needs in part	-	1.65 Mm ³
	Maharashtra		
"1)	Irrigation needs of	-	132.27 Mm ³

396. According to the witness the variation of annual rainfall in the State of Maharashtra, is indicated and it is stated that the maximum annual rainfall of 3000 mm occurs in Western Ghat and sharply diminishes to 700 mm and less in Middle Maharashtra and then increase to 1500 mm in Vidarbha Region.

397. In Paragraph 2.3 of his Affidavit, the witness stated that the major problem is with soils and geological formations (mostly laterite) that are porous in nature, which do not hold water, and most of the rain water is drained away either as surface rainfall in monsoons or subsoil flows in post-monsoon period in the month of December, which has historically resulted in monocropping of paddy for most holdings and some scattered plantations of coconut, aracnut, cashew and mangoes.

398. In Paragraph 2.4 of his Affidavit, the witness has mentioned that the Government of Maharashtra had introduced irrigated agriculture in Konkan belt after 1960. According to the witness, in North Konkan the projects such as Surya, Bhatsa were taken up, whereas in South Konkan, Tillari (Dhamne) and Lower Tillari Projects were taken up in 1976 for hydropower generation and irrigation respectively. According to the witness after his appointment by the State of Maharashtra as an expert witness for the Maharashtra Government, he had visited the basin on 19.8.2017 to know the general status of the basin. In Dodamarg town, he met the Sarpanch of Virdi and from discussions with him, he found that significant number of persons from that area have migrated to Keri village in Goa, for better prospects and some of them have taken up Government jobs, and have settled down there. The witness further stated that he had visited Virdi village and dam site and found that the village Keri is about 5 kms. from Virdi. According to him, his study reveals the total needs of Maharashtra in Mahadayi Basin, along with nearby Tillari valley villages, which has been summarised by him in the Table which reads as under:

"Figures in Mcum

SI.	Particulars	As per Study		
No.		In Basin	Outside Basin	Total
		(Mahadayi)	Tillari	
1.	Irrigation use	80.00	65.00	145.00
2.	Drinking	2.00	3.00	5.00
3.	Industrial	9.00	3.00	12.00
4.	Evaporati	9.00	9.00	18.00
	on losses			
5.	Hydro Power	0.00	0.00	0.00
	Generation (Non			
	consumptive)			
	Total	100.00	80.00	180.00

After referring to the Affidavit filed on 15.9.2015 by 399. Shri S.N. Huddar, expert witness for the State of Maharashtra, it is stated that the yield received in Maharashtra from the catchment area of 92.43 sg.km. would be 274.52 Mcum and 220.91 Mcum at 50% and 75% dependability respectively. The witness has averred that the use in Tillari basin, through a diversion is most natural, because the higher level cultivable fields in Tillari basin, can be then irrigated by gravity canals and this will at least partially compensate for the diversion already made by State of Goa to Mandovi basin from Tillari basin, (261.33 Mcum by State of Goa (Volume-102, Page 3). It is further stated by this witness that as per the availability per capita and availability per unit land both basins are abundant as seen from Maharashtra Water & Irrigation Commission Report, relevant period of which are produced by the witness as Annexure-3 (Colly) with his Affidavit.

400. In Paragraph 6.2, the witness has mentioned about the usual practice of considering water availability from entire basin to be followed and has mentioned that in fact, State of Goa, has already completed about 20 bandharas, 4 LIS and water supply schemes in this saline area of 509 sq. kms. The witness mentioned that most of the ferries in the 509 sq. kms. area in Goa, operating in vehicular or human transport, help only to cross the estuaries from one bank to another, and Western part of the 509 Sq. Kms. area in Mandovi basin is densely populated than any other area in the basin whereas the north eastern region i.e. Bicholim tehsil is pastoral. What is stated by the witness is that the claim by the State of Goa for impounding of flows by upstream States might result in increased siltation in estuaries and navigation channels, is in stark contrast to the principles of sediment transport in rivers because reduction in upstream eroding flows always results in less sediment as it is a blocked by dams upstream.

401. In Ex. MAH-MW2/1 which is a Study in respect of Water Needs of Maharashtra, in Mahadayi Basin, along with nearby Tillari Valley villages is given as under:

Figures in Mcum

SI.No.	Particulars	As per Study		
		In Basin	Outside Basin	Total
		(Mahadayi)	Tillari	
1	Irrigation use	80.00	65.00	145.00
2.	Drinking	2.00	3.00	5.00
3.	Industrial	9.00	3.00	2.00
4.	Evaporation	9.00	9.00	8.00
	losses			
5.	Hydro Power	0.00	0.00	0.00
	Generation (Non			
	consumptive)			
	Total	100.00	80.00	180.00

402. In question No.1 put by the learned Counsel for the State of Goa, the attention of the witness was drawn to the statement made by him in Para 5.1 at Page 11 of his Affidavit dated 27.10.2017, as well as MARK-MAH/3 (colly), which is Agreement dated 6.4.1990, entered between the Government of the State of Goa and the Government of the State of Maharashtra. Having drawn the attention of the witness to the relevant detail, the witness was asked as to whether he was in a position to cite or show any clause of the Agreement which contemplated or provided for compensating the share of water of Tillari basin, given to the State of Goa, under the agreement, to be compensated by any water from Mahadayi basin. In answer, the witness stated that he was not aware that any such clause existed in the aforesaid Agreement. The witness further stated that the word 'compensation' refers to any derogatory effects, if any, of transfer of water from Tillari caused due to the effect of the said Agreement.

403. In question No. 2, the attention of the witness was drawn to certain terms of the Agreement, MARK-MAH/3, and it was put to him that the consideration for the water allocated to the State Government under the Agreement is contemplated under Agreement itself, and that the State of Maharashtra need not be compensated further from the water of Mahadayi basin.

The witness answered that his answer to question No.1, part (b) had made it sufficiently clear that the word 'compensation' does not have basis or any relation to the referred Agreement between the States of Goa and Maharashtra.

404. After the cross-examination of the witness by the learned Counsel for the State of Goa, Shri Dattprasad Lawande, learned Advocate General for the State of Goa had made a statement that he had no further question to ask the witness in

his cross-examination. Thereafter, the Tribunal asked Shri Mohan V. Katarki, learned Counsel for the State of Karnataka to examine the witness, but he stated that he did not want to cross-examine the witness. Thereupon, few questions were put by the Tribunal.

405. In question No. 2 put by the Tribunal, attention of the witness was drawn to what he had stated in Para 3.5 at Page 8 of his Affidavit dated 27.10.2017, and the witness was required to explain and give reasons for variation in water demand for different purposes estimated by him and that included in the Further Amended Statement of Case of the State of Maharashtra.

The witness responded by stating that "I have no comment to offer to various parts of the question".

This is the sum and substance of the evidence of Shri B.C. Kunjir, (MW-2).

EVALUATION OF ORAL EVIDENCE LED BY THE THREE PARTY STATES

406. The Tribunal, now proposes to evaluate the testimonies of the expert witnesses examined by the three

States, namely the State of Goa, State of Karnataka and the State of Maharashtra.

Findings on Conflicting Results Arrived at by the Experts Relating to Water Availability

407. The study and examination of the CWC 2003 Report establishes beyond pale of doubt that CWC has estimated yield of Mahadayi basin at 75% dependability, to be 199.6 tmc. This very document together with data mentioned therein and findings recorded regarding estimation of yield has been, relied upon by all the expert witnesses who have been examined on the subject of Hydrology, either wholly or in part. However, the Tribunal is shocked and baffled to find that instead of reaching the same estimation of yield as arrived at by CWC, all the witnesses have given different figures of yield of Mahadayi basin at 75% dependability. The close scrutiny of the evidence tendered by them indicates that Shri Chetan Pandit has primarily reduced the value of the discharge observed at Ganjim site by 19% and reached a different figure of yield than what is mentioned in CWC Report. Similarly, Prof. A.K. Gosain has taken into consideration the data of longer period for estimation of yield at 75%

dependability. Shri A.K. Bajaj, expert witness examined on behalf of State of Karnataka has virtually adopted the yield figure arrived at by Prof. A.K. Gosain, without making any in-depth study at all. Shri S.N. Huddar, expert witness examined by the State of Maharashtra has adopted the figure mentioned in CWC 2003 Report but has added the input from Tillary basin. That is how he has estimated the highest yield of Mahadayi basin at 75% dependability. Shri S.T. Nadkarni, expert witness examined by the State of Goa has worked out yield of Mahadayi basin at 75% dependability for various sub-basins of Mahadayi. Therefore, when such approaches are adopted by expert witnesses which are not rational, it becomes highly difficult for the Tribunal, to place reliance on the evidence tendered by the expert witnesses.

It may be mentioned that after the oath was administered to each expert witness by the Tribunal before recording of evidence, each witness was in no uncertain terms, was informed by the Tribunal that he was an officer of the Tribunal and therefore he should, to the best of his capacity, assist the Tribunal, in arriving at true and correct figure of yield of river Mahadayi basin at 75% dependability. However, the Tribunal notices with pain that all the expert witnesses have failed to discharge their duties to assist the Tribunal to enable it to arrive at correct figure of the yield of Mahadayi basin at 75% dependability.

It is well to remember that all the expert witnesses are remunerated one. They have not only been engaged by the respective States to boost up their respective cases, but have deposed in a manner which favours the State concerned, which has appointed him and requested him to depose before the Tribunal.

It would not be out of place to mention here that Shri Chetan Pandit, deposing as an expert witness on behalf of the State of Goa, has filed four affidavits. In the first affidavit filed on 15.09.2015 (Volume 165), yield of Mahadayi Basin at 75% dependability was not mentioned at all. Shri Chetan Pandit has filed another affidavit dated 4.8.2016 (Volume 191), wherein the yield of Mahadayi Basin at 75% dependability was estimated to be 154.4 tmc for the total area of 2032 sq.km. and at 115.7 tmc for the catchment area admeasuring 1523 sq.km. During the course of his cross-examination, he has substituted the yield figure on the ground that there was a computer mistake. He has substituted the figure of 154.4 tmc by 151.47 tmc in respect of yield of Mahadayi Basin at 75% dependability for the total area of 2032 sq.km.

In the third Additional Affidavit of Examination-in-Chief, filed on 12.9.1996 (Volume 192), Shri Chetan Pandit has not given any figure of yield of Mahadayi Basin at 75% dependability.

In the fourth Additional Affidavit-in-Evidence, filed by Shri Chetan Pandit on 4.1.2017 (Volume 196), he has given the yield at 75% dependability at particular project locations, but has not mentioned total yield of Mahadayi Basin at 75% dependability.

Prof. A.K. Gosain, expert witness, examined on behalf of the State of Karnataka, has filed his first affidavit dated 15.09.2015 (Volume 166), wherein he has estimated the yield of Mahadayi Basin at 75% dependability to be 206.14 tmc. Prof. Gosain, expert witness, has filed Additional Affidavit to be treated as Examination-in-Chief on 15.11.2016 (Volume 193), but in the said affidavit, particulars about yield assessment at projects sites are provided and not the figure of yield of Mahadayi Basin at 75% dependability. Prof. A.K. Gosain filed further Affidavit on 24.3.2017 (Volume 197) and by the said Affidavit he has properly affirmed and verified his own Affidavit sworn on 12.9.2015. Prof. A.K. Gosain has further filed Affidavit on 11.05.2017 (Volume 198), wherein only gross yield for entire Mahadayi Basin, taking into consideration the years beginning from 1928-29 to 2012-13, using revised regressing equation, is shown to be 202.55 tmc at 75% dependability.

Shri A.K. Bajaj, deposing as an expert witness on behalf of the State of Karnataka has filed his Affidavit on 30.12.2016 (Volume 194), in which, after placing reliance on the yield at 75% dependability as mentioned in CWC (2003) Report, he has used the yield of Mahadayi Basin at 75% dependability to be around 200 tmc for his water balance study.

Shri S.N. Huddar, deposing as an expert witness on behalf of the State of Maharashtra, has filed Affidavit on 15.09.2016 [Volume 163(a)] and he has estimated the yield of Mahadayi Basin at 75% dependability to be 5913 Mcum (208.73 tmc). Shri S.T. Nadkarni, deposing as an expert witness on behalf of the State of Goa, has filed Affidavit on 14.11.2017 (Volume 208), wherein, after dividing Mahadayi Basin into Sub-basins, he has estimated yield for each Sub-basin and thereafter, he has arrived at the yield figure at 75% dependability to be 3283.30 Mcum (115.9 tmc). However, he has adopted the value of yield estimated by Shri Chetan Pandit for the entire basin without making his independent study.

It may be mentioned that Shri Chetan Pandit in his Affidavit dated 4.8.2016 (Volume 191) on page 39, has stated that every catchment invariably presents a different challenge in terms of availability of data and the accuracy of that data. In view of this statement of fact made by Shri Chentan Pandit, the exercise undertaken by Shri S.T. Nadkarni to determine the yield on the basis of Sub-divisions of Mahadayi Basin by using the regression equation developed by Shri Chetan Pandit becomes redundant and cannot be acted upon.

In view of the above stated state of affairs, the Tribunal is left with no option but to carry out its own assessment for the

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purpose of estimation of yield of Mahadayi Basin at 75% dependability.

Further, in the Statement of Case, filed by the State of Goa, the yield of Mahadayi Basin at 75% dependability is mentioned to be 108.72 tmc, whereas in the Statement of claims, filed by the State of Karnataka, the yield of Mahadayi Basin at 75% dependability is estimated to be 199.6 tmc.

The State of Maharashtra by filing Statement of Case on 02.01.2013 (Volume 27), has estimated the yield of Mahadayi Basin at 75% dependability to be 3164 Mcum (111.7 tmc).

In its amended Statement of case, filed on 2.4.2014 (Volume 74), the yield at 75% dependability is maintained as the same as mentioned in Volume 27. The State of Maharashtra has further filed Amended Statement of Case on 20.4.2015 (Volume 127) and maintained the same figure of annual yield.

However, the Tribunal finds that the expert witnesses, examined by the three States, have presented different figures of yield of Mahadayi Basin at 75% dependability. Thus, there is variance between pleading and proof. A party is expected and is bound to prove the case as alleged by him. This is in accordance with the main principle of practice that a party can only succeed according to what was alleged and proved secundum allegata et probate. The ordinary rule of law is that evidence should be only on plea properly raised and not in contradiction of the plea. A party cannot be allowed at the trial to change his case or set up a case inconsistent with what he has alleged in his pleading, except by way of amendment of the pleading under Order 6 Rule 17 of the CPC. Finding of a Court or Tribunal cannot go beyond pleadings and no amount of evidence can be looked into upon a plea which was never put forward. In the absence of any plea or issue, no evidence can be considered to be relevant and cannot be taken into consideration. A party cannot be allowed to lead evidence in contradiction of what has not been pleaded in the pleading. The Rule of secundum allegata et probate is based mainly on the principle that no party should be taken by surprise, by the change of case, introduced by the opposite party. A variation which causes surprise and confusion, is always ooked upon with considerable disfavour. The principle of 'variance between pleadings and proof' is very much attracted in the matter of appreciation of evidence. A party-litigant cannot be

allowed to take inconsistent position in Court, to play fast and loose, to blow hot and cold, to approbate and reprobate to the detriment of the opponent. This doctrine applies to successive stages in the same proceedings.

Here, in this case the Tribunal finds that there is great variance between the pleadings relating to yield of Mahadayi Basin at 75% dependability and the evidence adduced regarding yield of Mahadayi Basin at 75% dependability. When the Tribunal is faced with such a problem, the Tribunal is of the opinion that the higher figures of yield of Mahadayi Basin at 75% dependability mentioned by different expert witnesses will have to be taken into consideration, with a pinch of salt and cannot be blindly relied upon.

In the light of above stated principles, the evidence adduced by the three party-States through expert witnesses will have to be evaluated.

This Tribunal has heard the learned Counsel for the parties at length and in great detail. The Tribunal has not only considered the lengthy pleadings of the parties but has taken into account the written submissions, notes of argument and the law cited at the Bar. The written submissions and the notes of argument are not dealt with in detail in order to see that the Award which is otherwise lengthy, is not overburdened.

408. The same becomes evident, if one refers to Table I prepared by the Tribunal, which reads as under:-

SI. No.	Sources	Water availability at 75% Dependability
1.	Affidavit of Shri S.N. Hudda	r : 208.73 tmc
2.	Statement of Prof. A.K. Gos during cross examination	ain : 206.17 tmc
3.	Report of Prof. Gosain of September 2015, Case II	: 206.14 tmc
4.	Report of Prof. Gosain of September 2015, Case I	: 204.24 tmc
5.	Report of Prof. Gosain of May 2017, Case II	: 202.55 tmc
6.	Statement of Claims of the State of Karnataka	: 199.60 tmc
7.	Report of Prof. Gosain of May 2017, Case I	: 198.42 tmc

8.	Affidavit of Shri Chetan Pandit	: 154.40 tmc
9.	Statement of Shri Chetan Pandit during cross examination	: 151.47 tmc
10.	Statement of Case of the State of Goa	: 145.05 tmc

Note-1:

Shri Nadkarni has made assessment of Sub Basin wise for the area of 1523 sq.km. as 115.99 tmc (Ref. 13), which is slightly more than the estimate of 115.7 made by Shri Chetan Pandit and Shri Nadkarni has stated that he agrees with the calculation of yield made by Shri Chetan Pandit (Ref. para 8 above) i.e. 154.40 tmc relating to whole Mahadayi basin.

Note-2:

The State of Maharashtra has not made separate assessment of water availability for entire Mahadayi Basin and has relied upon the testimony of Shri S.N. Huddar.
409. Thus a bare glance at the above mentioned table, makes it evident that there are serious conflicts of opinion between the same and/or between more than one experts. Under the circumstances, a vital question which arises for consideration of the Tribunal is as to how the evidence of expert witnesses should be evaluated and what should be the approach of the Tribunal, in case when conflicts of opinion between experts are found to be substantial in nature by the Tribunal.

<u>Principle Governing Appreciation of the Oral Evidence given by</u> <u>the Witnesses on Hydrology.</u>

410. Tribunal notices that Section 45 of the Evidence Act, 1872, deals with the opinion of third person, when delivered. It is well settled that it is not the providence of an expert to act as judge or jury. An expert is not a witness of fact and his evidence is really of an advisory character. The duty of an expert witness is to furnish the Court with the necessary scientific criteria for testing the accuracy of the conclusion, so as to enable the Court to come to an independent judgment. The law of evidence is designed to ensure that the court considers only that evidence which will enable it to reach a reliable conclusion. The expert opinion has to be well reasoned. He must make available to the court, all materials which induced him, to opine in a particular direction. The expert evidence is merely a piece of evidence. A judge of fact will have to consider that evidence, along with the other pieces of evidence. Expert's evidence by its very nature is only an opinion evidence. An expert only aids and helps the Court by his opinion. The expert does not decide. He only helps and assists the Court to decide. It hardly needs to be emphasized that the opinion of an expert cannot substitute or take the place of proof in a trial. An opinion of an expert is not beyond the judicial scrutiny. In a given case, the Court need not accept the opinion given by an expert, when other reliable evidence in proof of a fact in issue is available. The essential principle governing the expert evidence is that an expert is not only to provide reasons in support of his opinion, but the results should be directly demonstrable. The Court is not to surrender its own judgment to that of the expert, or its authority to a third party, but has to assess the expert evidence like any other. If the report of an expert is slipshod, inadequate or unsatisfactory, then his opinion is of no use. Where several experts give the evidence, expected in favor of the parties by whom they are called, it can carry a little weight, when one expert is contradicted by the other. When the court finds that there is conflict of opinions, rendered by several experts, opinion of any one of them cannot be preferred on conjectural reasons. What is important to keep in mind is that the expert evidence produced by an interested party, may have certain amount of unconscious bias in favour of that party. When an expert is produced by one of the parties, but the said expert fails to produce any book or literature in support of his conclusions, the conclusions cannot be relied upon merely on the face of it. Where both the parties to the dispute produce their expert witnesses supporting their respective claims, such contradictory reports, which do not lead to any reasonable conclusion, are liable to be discarded. The opinion of an expert engaged by a party suffers from an inherent fact that it is given by remunerated witness. He knows beforehand as to why he has been called as a witness, and what a party calling him wishes to be proved. It is not improbable that he has an unconscious bias in favour of the party, who calls him for tendering the evidence before a court.

411. These are the broad principles, on the touchstone of which, the evidence of an expert has to be appreciated. However, as far as Hydrologists are concerned, there is no reported case,

which guides this Tribunal as to in which manner the testimony of a Hydrologist should be assessed. Notwithstanding, the absence of law laying down principles as to how the evidence of a Hydrologist should be evaluated, the Tribunal finds that it would be worthwhile to refer to some portions of a book, titled as "Settlement of International and Inter-State Water Disputes in India" authored by Dr. B.R. Chauhan, which deals with the principles to be borne in mind, while appreciating the evidence of a Hydrologist. The said book was published in 1992 by the Indian Law Institute through its Director Mr. P.M. Buxi, New Delhi. From the Foreword written on January 26, 1992 by Dr. Upendra Buxi, a renowned Jurist, who was then the Honorary Director of Water Law Project, indicates that Dr. Buxi had commended that had prepared and presented "a lucid work for serious study for all concerned for the human rights reason that it would escalate our capabilities as citizen – scholars to mediate and shape public choice which will enable, the nation, to adjust to, in lamented Roscoe Pound's Striking Phrase, conflicts of interest with "least friction and waste". "As per the Foreword written by the eminent jurist Dr. Buxi, "Dr. Chauhan is a scientific leader in this field, acknowledged world-wide".

The distinction between <u>de lege-lata</u> and <u>de lege-ferenda</u> is explained in the treaty prepared by Dr. Chauhan in Chapter IV, at page 21, which relates to 'Theories on Sharing of International and Inter-State Water Resources'.

The relevant part of Chapter IV, is reproduced as under: "Distinction between *de lege-lata* and *de lege-ferenda*:

Sometimes, guided and overwhelmed by the considerations of narrow self-interest, a scholar places himself in the position of one of the disputant parties and as such starts emphasizing or defending a particular viewpoint so as to safeguard the interests of, say, the lower riparian or the upper riparian, as the case may be, and in that exercise he tries to justify or establish a particular theory or doctrine. In this manner the concerned scholar wraps up the law of his imagination, namely, the law as it ought to be or *de lege-ferenda*, in the motivated logic and tries to depict it as the prevailing law, viz. *de lege-lata*. Such an exercise is very harmful not only to the cause of research and legal knowledge but also can create havoc if somewhere the norms so suggested, or mixed up, find application in the settlement of actual water dispute."

Evaluation of Oral Evidence of AW-1 Shri Chetan Pandit for the State of Goa

412. Shri Chetan Pandit, AW1, has been examined, as an expert witness by the State of Goa on the topic of "Hydrology-Availability of Water". Shri Chetan Pandit says that he is a Hydrologist by profession, and has worked with the Central Water Commission for more than 35 years. According to him he has also advised, the State of Goa, on various aspects, including formulation of its water policy. He claims to have, extensively visited the Mahadayi Basin in the State of Goa, as well as the spots of origin of the River Mahadayi in Bhimgad Sanctuary in Khanapur Taluka, in the Belgaun District, and other Mahadayi Basin areas, in Karnataka. According to him the State of Goa had requested him to conduct a study on water availability in the Mahadayi Basin and to depose before the Tribunal. That is how, he claims to have prepared his study and affidavit.

413. Shri Chetan Pandit, has submitted his study, before the Tribunal as Report dated 3.8.2016 (Volume 191).

414. The Tribunal finds that the averments made in the said study, are general in nature, and no specific reference to standard tax of approved guidelines etc. for assessment of yield of Mahadayi Basin, by Shri Pandit, is mentioned therein. Further, the Tribunal notices that along with the said affidavit, no documents were annexed at all. Shri Chetan Pandit tendered an affidavit of examination-in-chief dated 4.8.2019, (Volume 191), before the Tribunal. Along with his affidavit Shri Pandit has annexed an Annexure-A, which is yield study of Mandovi (Mahadayi) Basin. The yield obtained by Shri Pandit is mentioned on Page 58 of Table 34, of his yield study of Mahadayi Basin. The same is as under:

Yield		МСМ	ТМС
Runoff over entire	50% Dependable	5039.8	178.0
Area 2032 SqKm	75% Dependable	4372.4	154.4
Usable Yield.	50% Dependable	3777.3	133.4
1523 SqKm	75% Dependable	3277.2	115.7

Table 34A- Yield in Mahadayi Basin

415. Shri Chetan Pandit has filed yet another affidavit of examination-in-chief dated 9.9.2016 which was tendered before

the Tribunal on 12.9.2016 (Volume 192). Along with his affidavit dated 9.9.2016, Shri Chetan Pandit has annexed an Annexure B, which is to be found on running pages 100 to 139 of his affidavit dated 9.9.2016. The witness has produced extract of the project approved in 2016, by the State of Karnataka within the territory of State of Karnataka as Annexure "C", titled "Projects Approved in 2016", which is to be found on pages 140 to 145 of his Additional Affidavit. Further, he has produced an Annexure D, which is at Page 146 of his additional affidavit of examination-inchief tendered before the Tribunal on 12.9.2016. Annexure 'D' is the photo copy of Flood Control and Utilization of Water in Bennehalla Basin, a Scientific Proposal. He has also filed his Additional Affidavit-in-Evidence dated 04.01.2017 (Volume 196).

416. From the affidavit and the documents produced by Shri Chetan Pandit, the Tribunal finds that, he has used the observed data of rainfall, very specifically identified rain-gauge station, in and around, the basin and the discharge data, observed by CWC gauging station, at Ganjim in the analysis, which are highlighted by him in his Report of August 2016 (Volume 191), and January 2017 (Volume 196). The Tribunal also finds that Shri Chetan Pandit has used, the rainfall data of 42 years from 1964 to 2005, in his Report, which is evident from what is stated in Paragraph 11 on Page 50 of Volume 191. In Para 28 on Page 12 of Volume 191, this witness has stated that there is not a single CWC gauging station on many significant tributaries of Mahadayi viz. Ragda, Kotni Nadi, Bail Nadi and Surla Nadi. He has stated that the rivers on which projects have been proposed by the State of Karnataka and Maharashtra are ungauged. Further, the Tribunal notices that non-establishment of gauging stations at significant tributaries and non-availability of observed discharge data at such tributaries, is not found to be, a hurdle and /or a constraint, for assessment of yield of Mahadayi Basin, and its tributaries, or for identified project sites. This has become apparent from the reply given by Shri Chetan Pandit to question No.159 put to him by the Tribunal on 6.10.2016, wherein he, inter alia, stated "also I do not recommend runoff relationship for small catchment developing rainfall because, as the catchment gets smaller and smaller, the relationship becomes less and less stable. Finally, I would also add that, when I examined the Report, earlier prepared by others, I had seen, that they too have focussed only on the Ganjim data. Therefore, while my study is independent, using only Ganjim data, would make it easier to compare the results".

417. In Para 19 at Page 8 of his affidavit (Volume 191), Shri Pandit has reported the result of his study, wherein the water availability of Mahadayi Basin has been indicated by him as under:

Runoff over entire catchment area of	=154.4 tmc
2032 sq.km at 75% dependability	
Runoff over entire catchment area of	=178.0 tmc
2032 sq.km at 50% dependability	

418. However, in answer to question No.154 put to Shri Pandit, by the Tribunal on 5.10.2016, he has admitted that due to some software error found in the 2003 version of Microsoft Office, the valuation indicated in his affidavit (Volume 191) needed corrections and he has stated that, the re-assessed value of the water availability for the entire Mahadayi Basin, is as under:

Runoff over entire catchment area of =151.47 tmc 2032 sq.km. at 75% dependability

Runoff over entire catchment area of =175.16 tmc 2032 sq.km. at 50% dependability

419. Thus the Tribunal is of the opinion that due care was not taken by Shri Pandit when he reported the results of his study in his affidavit (Volume 191).

420. Another important aspect of the matter is that, Shri Pandit has not included detailed analysis of the discharge data observed at Collem in his Report of August 2016 (Volume 191). In Para 13 on Page 51 of Volume 191, Shri Pandit has mentioned that a small kink is seen around 1987 and then again around 2000 but the Tribunal finds that no explanation is offered by Shri Pandit as to why kink of 1987 was found.

421. With a view to ascertaining whether Shri Pandit had examined, all facts, and had undertaken proper test, before assuming that necessary correction factor, for converting surface velocity of flow measured by float, into mean velocity was not applied by CWC, the Tribunal had put question No. 176 to him which is as under:

"Q.No.176: Have you examined the observed data sheet of Central Water Commission (CWC) in respect of observations during the period from 1979 to 2000 to check whether coefficient as prescribed in ISO 748:2007/IS-1192:2013 (MARK-14) has been applied as multiplication factor by CWC to covert the surface velocity observed by float measurement into mean velocity or not?"

422. The reply given by him was that he had not checked the CWC's original data at the site. The Tribunal further finds that in view of the averment made by Shri Chetan Pandit in his Report of 2016 (Volume 191), and his reply to various questions, the contention of the State of Goa that there was no actual gauging of (a) the river Mahadayi, covering the entire basin at each of the tributary and (b) rain to assess the complete yield of the river, has no substance.

423. On the basis of averments made by Shri Chetan Pandit in his Report of 2016 (Volume 191) and his replies to various questions, it is evident that he has considered the existing rain gauge stations as adequate and has used the observed data of these stations, with or without corrections/modifications for the purpose of assessment of yield of Mahadayi river basin, as also the yield at various project sites within the Mahadayi basin. Thus, the contention of the State of Goa that the data available at various observation Stations, particularly the Hydrometeorological and Hydrological observation Stations, are not reliable and adequate, cannot be accepted.

424. Further, the case of the State of Goa that the gauge data collected at Ganjim site is unreliable, is not fully established in view of the averments made by Shri Chetan Pandit, in his affidavit and Report. Further his affidavit and Report indicate that the State of Goa had excluded initially 1050 sq.km, out of total catchment area of 2032 sq.km, for the purpose of, estimation of water availability, at different dependability, with specific Issue No. 24 framed by the Tribunal. The Tribunal notices that, this exclusion of 1050 sq.km has been discussed in Para 15 at Page 55 of his Report of August 2016 as under:

"Thus in this case of Mandovi River basin while the total yield may be estimated for a catchment area of 2032 sq.km, usable yield has to be estimated only on the area 1523 km² being = 2032-509 km²."

425. The above statement of Shri Pandit presents a clearly different scenario from what is reflected in the specific issue framed for determination i.e. Issue No. 24, which is based on Para 179E, on Page 217, Para 179L, on page 221, and Para 179M on Pages 221-222, of the Statement of the Case of the State of

Goa (Volume 131). The Tribunal notices that question No. 173 put to Shri Chetan Pandit related to meaning to be ascribed to words "definition of yield", as given in Indian Standard Code, or that included in the Report of the Cauvery Water Disputes Tribunal. He was also requested to give reasons for dis-agreeing with the definition of yield, as given in Indian Standard Code, or that included in the Report of Cauvery Water Disputes Tribunal. The Tribunal notices that in his reply Shri Chetan Pandit did not specifically convey, his dis-agreement with the definition of yield, as given in the Indian Standard Code or that included, in the Report of Cauvery Water Disputes Tribunal.

The Tribunal finds that from the averments made by Shri Pandit, in his affidavit and Report, it is evident that the contention of the State of Goa that "for the purpose of estimation of water yield at different dependability, an area of 1050 sq.km. is required to be excluded" cannot be accepted. The Tribunal finds that the approach for the study adopted by Shri Pandit to estimate the yield of Mahadayi Basin, is broadly similar to the approach followed by Central Water Commission (CWC) in its Report of 2003 (Volume 15) and those followed by Prof. A.K. Gosain, an expert witness of the State of Karnataka, in his Report of September 2015, (Volume 166), and subsequently in his Report of May 2017, (Volume 198-198A). The Tribunal further finds that various steps followed for completion of the study by Shri Pandit, Prof. Gosain and CWC are also the same, except for two steps, namely, (a) catchment area for the estimation of yield, and (b) correction for discharge observed by Float Method, which constitutes part of the Report of Shri Chetan Pandit only.

426. On appreciation of evidence of Shri Chetan Pandit, the Tribunal finds that Shri Pandit, has estimated the average rainfall for the catchment, upto proposed project site, by using the rain gauge station, in and around the basin, using Arithmetic Means Method. As a matter of fact, the Tribunal notices that, rainfall data of only one rain gauge station has been used, by Shri Pandit, for most of the project sites.

427. It is to be noticed that the term 'annual runoff', mentioned in Issue No. 10, has not been used by Shri Pandit in his affidavit and Report of August 2016 (Volume 191) instead, Shri Chetan Pandit has used the phrase 'runoff of entire catchment', or 'total yield', and 'usable yield'. Shri Pandit has, accordingly, estimated the runoff, over the entire catchment and has worked out the usable yield at 50% dependability, and 75% dependability. What is noticed by the Tribunal is that in his affidavit and Report of August 2016, Shri Pandit has not at all used the term 'natural safe yield' which is the case of the State of Goa included in the pleadings filed by it.

428. During the course of giving reply to question No. 155, it was stated by Shri Chetan Pandit that he had used 2003 version of Microsoft, which includes a programme called 'Excel', for Arithmetic operation, and software errors have been found in the two versions, namely INTERCEPT and SLOPE but he had used the said software in his good faith and completed his Report.

429. From the testimony of Shri Chetan Pandit, the Tribunal finds that there are considerable variations in respect of yield i.e., runoff over catchment area. While the 75% dependable runoff, is stated to be 145.05 tmc in the Statement of Case of the State of Goa, on the basis of which Issue No. 10 was framed, Shri Pandit in his Report of August, 2016 (Volume 191) has indicated a figure of 154.4 tmc. Even revised figure of 151.47 tmc, indicated by Shri Chetan Pandit, during his cross-examination, is found to be considerably more than the value mentioned in Issue No.10. Thus, the Tribunal is of the firm opinion that the Issue No. 10, as it is in its present form, has not been supported by Shri Pandit, either with reference to specific terms used or in respect of the values of 75% dependable yield, or 50% dependable yield. Further, the Tribunal finds that the application of correction by Shri Pandit, for discharges observed by Float Method, is found to be uncalled for, since the correction for converting the velocity measured by using Float into Mean velocity, constitutes a part of the routine process, to be performed during field observation and computation, before according the measured discharge data for the day.

430. From the facts that have emerged during the course of cross-examination of Shri Chetan Pandit, it is noted by the Tribunal that there are various instances of inconsistencies in the data used by him, as also in the data processed by him. The Tribunal notes that the procedure for development of rainfallrunoff model has not been strictly adhered to by Shri Pandit, as laid down in the (i) "Guidelines for Preparation of Detailed Projects Reports of Irrigation and Multipurpose Projects" of the Govt. of India, Ministry of Water Resources, published in 2010, which is MARK-5 (ii) "Introduction to Linear Regression (Third Edition) by Douglas C. Montegomery, Elizabeth eth A. Peck, and G. Geoffrey" Vining (MARK-31) (iii) "Chapter A3 Statistical Methods in Water Resources by D.R. Helsel and R.M. Hirsh of Book 4, (iv) Hydrologic Analysis and Interpretation of the United States Geological Surveys (USGS)" (MARK-32), and (v) "Training modul SWDP – 37 –How to do hydrological data validation using regression prepared under Hydrology Project by DHV Consultants BV & DELFT HYDRAULICS" (MARK-3).

431. One of the major flaws found by the Tribunal in the testimony of Shri Chetan Pandit, is the procedure adopted by him for estimation of water availability, which relates to applying a correction factor of '0.84', to the discharges observed by CWC at Ganjim site, for the period from 1979 to 2000, thereby, reducing the quantum of observed runoff. The Tribunal finds that this again, on the part of Shri Pandit, was based on his assumption that the prescribed correction factor to convert surface velocity to mean velocity, at the time of discharge observation by 'Float Method', was not applied by CWC, while computing the daily discharges at the site. However, the Tribunal finds that his assumption is factually incorrect, since Surface Velocity' was already converted into the 'mean velocity' by applying a

correction factor of "0.89" by CWC, which is apparent from "Velocity Observation by Float dated 3.7.01 prepared by CWC at Site No.25A, Ganjim" (MARK-15 colly). Thus the process of reducing the value of the annual runoff by Shri Pandit, and using this reduced value, of runoff, for development of rainfall runoff model is erroneous and unwarranted.

432. Under the circumstances the Tribunal is of the firm opinion that, the assessment of water availability of Mahadayi River Basin, made by Shri Chetan Pandit, (which is based on a model developed by him using the runoff data modified on the basis of an erroneous assumption resulting into under estimation of runoff), cannot be considered as reasonable and reliable. The Tribunal records a finding of fact that the assessment of water availability, as projected by the State of Goa, and, the one reported by Shri Pandit in his Report, are apparently on lower side and it is not safe to accept the same.

Evaluation of Oral Evidence of RW-1 Prof. A.K. Gosain for the State of Karnataka

433. Prof. Gosain, RW-1, expert witness for the State of Karnataka has filed 3 separate Affidavits-in-Evidence dated

September 12, 2015, November 15, 2016 and May 11, 2017, which are given Volumes No. 166, 193 and 198, respectively, by the Tribunal. In his affidavit dated 12th September, 2015, Prof. Gosain has also attached a Study conducted by him, titled as "The Yield Study of Mahadayi Basin". The said Study dated 12th September, 2015, has been annexed by him to his affidavit as 'Annexure B', and the conclusions of the said Study are enumerated in paragraph 7 therein.

434. A bare glance of the said Study makes it evident that Prof. Gosain has relied on the same data, that has been used by the CWC, and that he has also relied on IMD data.

435. After going through the affidavits and Reports of Prof. A.K. Gosain, RW-1, Expert Witness of the State of Karnataka, the Tribunal finds that, he has estimated different values of water availability of Mahadayi Basin, in his Report of September 2015 (Volume 166), and Report of May, 2017 (Volume 198), as under:

SI. No.	Reference Document	Water availability at	Water availability at
		75%	50%
		dependability	dependability
1.	Report of September		
	2015 of the Expert	204.24 tmc	224.61 tmc
	Witness (Case-I)		
2.	Report of September		
	2015 of the Expert	206.14 tmc	223.20 tmc
	Witness (Case-II)		
3.	Report of May 2017 of		
	the Expert Witness	198.42 tmc	215.59 tmc
	(Case-I)		
4.	Report of May 2017 of		
	the Expert Witness	202.55 tmc	216.89 tmc
	(Case-II)		

436. With regard to the findings and conclusions of his Study, Shri Gosain has stated as under:-

"It may be observed that 50% and 75% dependable analysis gross yield of Mahadayi Basin, works out by using the extended data with the old R-R Model is not very different from the one, obtained by revising the R-R Model, after incorporating the additional runoff observations. Hence, it is recommended to use 50% and 75% dependable gross annual yield for Mahadayi Basin as 6321 Mcum (223.20 tmc) and 5838 Mcum (206.14 tmc) respectively, since it is the outcome of a correct procedure." 437. Further, in his Additional Affidavit-in-Evidence dated 15th November 2016, (Volume 193) Shri Gosain has conducted a "Supplementary Study of Yield Assessment at Project Site", which is annexed to his Affidavit as 'Annexure A'. This Report is limited to the assessment of water availability in respect of projects, planned and proposed in the Mahadayi Basin and situated within the territory of the State of Karnataka. He has used the proportional area method with the rainfall factor of nearest observation rainfall to the Main Gauged Sub Basin rainfall. The results of Supplementary study obtained by Shri Gosain are as under:-

Projects	50% dependability	75% dependability
Kalasa Dam	4.6 tmc	3.8 tmc
Bhandura Dam	4.6 tmc	3.7 tmc
Kotni Dam Site	23.9 tmc	19.4 tmc
Kotni Dam Site (Independent	13.4 tmc	10.6 tmc
catchment)		
Bailnadi Dam (Diversion)	4.4 tmc	3.7 tmc
Irti Dam (Diversion)	1.2 tmc	0.9 tmc
Irti Pickup Dam (Independent	1.5 tmc	1.2 tmc
catchment)		
Diversion of Kotni Basin		
1. Kalta-Palna	3.0 tmc	2.5 tmc
2. Diggi Diversion	2.1 tmc	1.8 tmc
3. Viranjole	1.0 tmc	0.8 tmc

438. Shri Gosain has filed an Affidavit-in-Evidence dated 11th May, 2017, (Volume 198), titled as "Affidavit in Support of the Analysis of Yield of Mahadayi Basin taking Rainfall Data from 1928-29 and 2012-13". Shri Gosain has attached the said Analysis to his said affidavit as 'Annexure A (Colly.)'

439. Along with the Affidavits-in-Evidence dated 12.9.2015 (Volume 166), 15.11.2016 (Volume 193) and 11.5.2017 (Volume 198), respectively, Shri Gosain has also relied upon the following documents:-

- (a) Bio Data, enclosed which is affidavit dated 12.9.2015 as 'Annexure A' to the said affidavit.
- (b) Report dated 12.9.2015 with Appendices I to XIII, marked as Exh. KAR-RW1/2(Colly.)
- (c) Supplementary Study for Yield Assessment at Project Sites, at 'Annexure A', to his affidavit dated 15.11.2016 (Volume 193), marked as EXH. KAR-RW-1/3.
- (d) Letter dated 3.10.2013, issued by the Office of the Chief Engineer Water Resources Department, Govt. of

Karnataka, along with a brief note on the subject, marked as MARK-KA/5(Colly.).

- (e) Documents containing the proceedings of the Govt. of Karnataka, and also order dated 9.10.2015, approving the appointment of Shri A.K. Goyal, w.e.f. 12.8.2015, marked as MARK-KA/6.
- (f) The documents produced by the witness about his visit to the Mahadayi Basin, from 5.11.2015 to 7.11.2015, marked as MARK-KA/8.
- (g) Data for the Stations, i.e. Valpoi, Ponda, Panjim, Mapuca, Sanguem, Khanapur, Kanakumbi, Jamagaon and Amagaon for the years from 2001-2002 to 2012-13, marked as MARK-KA/9 (Colly.).
- (h) Analysis, along with Annexures I to IX dated 9.5.2017, prepared by him, which is marked as Exh. KAR-RW-1/6 (Colly.), which is referred to his Report dated 9.5.2017 (Vol.198).
- (i) Hard copy of the data and the computations, made for RR Relationships, with and without, the omitted data of 1979-80, along with the subsequent computation of the yield, marked as Exh. KAR-RW1/7.

440. Shri Gosain was cross-examined in great detail and length, on behalf of the State of Goa, by Shri Atmaram N.S. Nadkarni, learned Senior Counsel, and by Shri Dattaprasad Lawande, learned Advocate General of the State of Goa. The cross-examination of the witness was with reference to, inter alia, his Affidavits-in-Evidence and the documents produced by him.

441. From the cross-examination of this witness, it becomes evident that Shri Gosain was asked questions, virtually, on every topic and issues included in his Study, to gain clarity and to understand what is stated in his Reports. Certain questions were also put to Prof. Gosain by the Tribunal.

442. A fair reading of his testimony makes it very clear that he is a knowledgeable and competent expert. However, in the instant case, the Tribunal has found some inconsistencies, in the studies conducted by Prof. Gosain, as well as the inconsistencies emerging from the answers given by him in his crossexamination, which are basic in nature, and go to the root of the matter. 443. The Tribunal proposes to point out certain fundamental inconsistencies, which are found in the testimony of Shri Gosain. These are as under:-

Prof. A.K. Gosain, has not made use of the observed (a) discharge data at Chapoli Site of the State of Karnataka or that of any other Site of the State of Goa or the State of Maharashtra. The Tribunal finds that the details of this specific procedure for the assessment of water availability made at Haltar Dam, Kalasa Dam, Kotni Hydro-Power Dam, Bailnadi Dam Site, Bhandura Dam Site, the entire catchment in Karnataka and Ganjim G&D Site of main river, Khandepar at Collem G&D Site and entire catchment up to the mouth of the sea of Goa are neither described in the Amended Statement of Claims of the State of Karnatakla (Volume 129) or in any other document, filed by the State of Karnataka. It is worth observing that the available observed discharge data at Chapoli Site maintained by the State of Karnataka, has not been used, even for assessing the yield at Kotni Dam Site, which is a little surprising. The observed discharge data at Chapoli is also not taken into account, in consistency checks, etc.

- (b) On 18.5.2017, Shri Gosain volunteered that when he worked out the yield, by using the R-R Relationship derived after incorporating the omitted year of 1979-80, as given at page 4 of the document Exh.KAR-RW-1/7, and the re-computed yield, then the 75% dependable yield of Mahadayi Bain comes out to be 206.17 tmc and at 50% dependable yield comes out to 223.06 tmc, versus the earlier results, wherein the 75% dependability yield was 206.14 tmc and 50% dependability yield was 223.20 tmc.
- (c) In question No.28, put by the Tribunal, Prof. A.K. Gosain, on 14.7.2017, wherein he was informed about the availability of daily discharge data from the hydrological observation maintained at Chapoli and also at several other Sites maintained by the States of Goa and Maharashtra, for different periods, Prof. Gosain was asked as to why this valuable information, had not been used for the purpose of assessment of

water availability. In answer, Prof. Gosain stated that he had decided not to use the same for his analysis. Prof. Gosain further mentioned that the information in these data observations could be valuable for many purposes, but these data were pertaining to the smaller catchment and many of them were smaller in length, and therefore, were ignored. According to Prof. Gosain, the other reason for ignoring the said data was, on account of the fact that these daily discharge data were not maintained by any independent authority, and therefore, for his study, Ganjim data, which had adequate length and was for a much bigger size of the basin, was taken into consideration by him.

444. In view of what is stated by Prof. Gosain, and the information provided by him, in his answer to the questions put to him by the Tribunal, the Tribunal is of the opinion that without any cogent and convincing reasons, Prof. Gosain had excluded the observed discharge data at Chapoli for the purpose of assessment of water availability in respect of (a) Haltara Dam, (b)

Kalasa Dam, (c) Kotni Hydro-Power Dam, (d) Bailnadi Site, and (e) Bhandura Dam Site.

445. From the testimony of Shri Gosain, it becomes at once evident, that he has not even cared to look into the CWC's selection of Rainfall Stations, and has used the data of the same Rainfall Stations, as used by CWC in its Report, without independently examining as to whether selection of Stations made by CWC was proper and up to the mark. This is, despite being required and expected to do so, as an Expert. In fact, in answer to questions No.126 and 127 asked by the learned Counsel for the State of Goa, Prof. Gosain, has categorically stated that "while preparing my report dated 12.9.2015, my objective was to build on the detailed work done by the CWC, through their Report CWC (2003)", therefore, I did not get into the process of selection of any other non-IMD Rain-gauge Station. Similarly, like CWC, Shri Gosain has without any cogent reason, and without any proper application of mind, accepted the unusually high runoff factors at Ganjim and has not taken care to re-examine the same, for the reasons best known to him. Prof. Gosain was unable to provide the Tribunal any cogent explanation as to why he had accepted the unusually high runoff factors at Ganjim and why he has not re-examined the reasons for high runoff factors and had decided to blindly follow what was stated in CWC (2003) Report.

446. Several deficiencies in respect of filling in missing data were brought to the notice of the Tribunal by the learned Counsel for the State of Goa, during the cross-examination of Prof. A.K. Gosain. The Tribunal had also prepared detailed statements, indicating variations, in the values of Rainfall for the same rain-gauge stations, which were mentioned in the two Reports, i.e. Report of September, 2015, (Volume 166) and Report of May, 2017, (Volume 198). These statements prepared by the Tribunal, are MARK-26 and MARK-27, respectively. When these inconsistencies in the data used, in two different Reports were brought to the notice of Prof. A.K. Gosain, he in his reply to question No.57 put to him on 18.7.2017, inter alia stated as under:

"...The variations between my Report of September 2015 and my May 2017 Report, as depicted in MARK-26, are on account of additional data, that was earlier missing, becoming available from IMD, as reported in the respective footnotes of the various Annexure Tables. The other reason of these variations can also be the result of the application of consistency checks..."

447. Prof. Gosain has not explained as to why the IMD data of previous years were missing and how these data became available at the time of preparation of Report of May 2017. In reply to question No.58 put to Prof. A.K. Gosain on 18.7.2017, inter alia, stated as under:-

"...The variations in the Comparison Table (MARK-27) are on account of the fact that due to some reason the data of this Station is not consistent, as can be made out from the averages provided for various periods as part 'c' of the question. While doing the September 2015 Report, since the decision was taken to use the processed data prior to 2001, for all the Stations as by CWC (2003) Report, done therefore, no reprocessing of this data could have been meaningful. While performing the May 2017 study, reprocessing of the whole rainfall data sets with respect to infilling and consistency analysis was done. As it can be observed from column 4 of MARK-27, that the data prior to 1981 is appreciably different from the data after 1981, as has been suggested by the averages of the period in the last two rows of column 4 of MARK-27..."

448. A bare reading of the above stated reply of Prof. Gosain makes it more than clear that Prof. A.K. Gosain could not explain,

as to what he meant by 'some reasons' and the reply given by him, which is reproduced, is indicative of presence of some errors, in the processed data included in the CWC Report of 2003 (Volume 15). Thus the Tribunal finds that the Reports submitted by Prof. A.K. Gosain are deficient in nature and become suspect.

449. Further the inconsistencies in the data included in CWC Report of 2003 (Volume 15), as well as the data included in September 2015 Report of Prof. Gosain (Volume 166), were brought to the notice of Prof. Gosain and in answer to question No.58, Prof. Gosain stated as under:-

"...It was through this analysis that in my study of May 2017, this Station of Castlerock was found to be violating the consistency and correction for consistency was made as per the details given in spread sheet 'Consistency RF 1964-12' of Vol. 199."

450. Here also, Prof. A.K. Gosain could not explain as to why the decision was taken by him to use the processed data prior to 2001, for all the Stations as was done by CWC (2003) Report, and why fresh analysis of the data was not undertaken by him. This would indicate that, except placing reliance on CWC (2003) Report, no actual exercise for analysis of the processed data prior to 2001, of all the Stations was undertaken by Prof. A.K. Gosain. This shows the easy method adopted by Prof. Gosain for preparing his Affidavits and Reports. The Tribunal finds, that the replies/explanations given by Prof. Gosain are far from satisfactory and raise more questions on the procedure, adopted by him, during preparation of his two Reports.

451. Similarly, the Tribunal finds that Prof. A.K. Gosain, has considered the observed data at Ganjim as correct and consistent, but he himself has chosen to ignore data of 9 years, out of 34 years during the process of development of Rainfall-Runoff Equation. Why the data for the above stated periods were ignored, has not been explained by Prof. Gosain. What is worthwhile noticing, is that the data of about 9 years out of 19 years, were also ignored by the Central Water Commission, while developing the Rainfall-Runoff Equation, and thus, except blindly following the methodology adopted by the Central Water Commission, no further fresh exercise, at all, was undertaken by Prof. Gosain. 452. At this stage, it would be relevant to reproduce question No.27 put to Prof. A.K. Gosain, by the Tribunal on 13.7.2017, and the reply given by him. The same is as under:-

"Q. No.27. We note that you have carried out detailed analysis in respect of homogeneity and consistency of flow data observed at Ganjim and the result of the same have been presented at Para 5.1.1.1, Para 5.1.12 and Para 5.1.2 at pages 26 to 30 of your September 2015 Report. You have also asserted at page 39 that the "observed series at Ganjim has been found consistent". However, we note that while carrying out the analysis for development of linear regression equation, Central Water Commission ignored the data set of as many as 9 years out of 19 years.

If the data of about 50% of the year, i.e. 9 out of 19 years in case of CWC Study of 2003, are required to be ignored, how can such data be considered as consistent and reliable?

Ans. With due respect, I would like to state that by excluding these 9 years out of 19 years from the process of formulating the R-R equation, does not imply that there is something wrong with the observed flow of these 9 years. They have been ignored by CWC as well as by me as part of the stipulated process, to ensure that there is no unnecessary bias on account of

such extreme events, in the R-R equation, since the equation is required to be used for extrapolation of runoff using the rainfall.

I would like to state that this explanation has been mentioned in CWC (2003) Report as well as my September 2015 Report."

453. On appreciation of the above reply, the Tribunal is of the firm opinion that the reply given by Prof. Gosain is not at all convincing and the Tribunal is constrained to conclude that the data of Rainfall or Runoff or both have certain element of doubts, and that the Report of CWC 2003, as well as the Report submitted by Prof. Gosain, cannot be, fully, relied upon.

454. What is important to notice is the fact that Prof. A.K. Gosain, had undertaken, an exercise to rectify the data used by the Central Water Commission in the Report of 2003 (Volume 15), which makes the data used by CWC, also doubtful.

455. The Tribunal finds that Prof. Gosain, has accepted, without scrutiny, the Rainfall Stations mentioned in the CWC (2003) Report. As noticed earlier, Prof. Gosain had not included the data of Gavali and Chapoli Stations in his study of September 2015 (Volume 166). However, subsequently Prof. Gosain had used, the data of Gavali and Chapoli Stations, in his study of November, 2016 (Volume 193). Therefore, guestion No.149 was put by the learned cross-examiner, on behalf of the State of Goa, to Prof. Gosain as to why he did not use the data of Gavali and Chapoli Stations in his September 2015 study. The Tribunal notices that Prof. Gosain refused to answer the said question by maintaining that it was "consciously decided to consider only 15 IMD Stations". Prof. Gosain, with great respect to him, failed to give a substantial reason for such important noticeable discrepancy. In the absence of any such explanation, the Tribunal is also unable to understand and perceive the reasons as to why data of Gawali and Chapoli Stations were not included in the September 2015 study of Prof. Gosain, and he left it to fend for itself. This compels the Tribunal to cast aspersions on the reliability of the Study made by Prof. Gosain.

456. A major contradiction comes to the notice of the Tribunal, that Prof. Gosain, in his subsequent Study as mentioned in Affidavit-in-Evidence dated 11th May, 2017, indicates the use of entirely different rainfall data, as compared to CWC (2003) Report (Volume 15) in his study as mentioned in Affidavit-in-
Evidence dated 12th September, 2015. In relation to this contradiction, question No.285 was put on behalf of the State of Goa to Prof. Gosain, and he answered the same by stating that to explain the difference found in his 2015 Study, and his Study conducted in May, 2017, he had not undertaken the processing of rainfall data himself and that he had used the processed data from CWC (2003) Report, whereas in his 2017 Study, he had done the data processing himself. What is important to notice is, that Prof. Gosain by giving the above mentioned explanation, has made CWC (2003) Report highly suspect. Moreover, it will be for Prof. Gosain to demonstrate as to how the study conducted by him in 2015 stands, despite the differences which were brought out by himself in his May, 2017 Study, which makes both the Reports unreliable. What is found by the Tribunal is that Prof. Gosain, has been unable to clearly and categorically explain the reasons for inclusion and exclusion of the discharge data, used by CWC, in his Studies of September 2015 and May, 2017. What is noticed by the Tribunal, is that by using different raw data sets, Prof. Gosain has virtually contradicted his own two Reports.

457. At this stage, it would be relevant to notice Issue No.35, which is as under:-

"Issue No.35. Whether the State of Karnataka proves that the total availability of water from the Mahadayi river basin within the State of Karnataka is 44.15 tmc (1250.19 Mcum) at 75% dependability and 52.60 (1489.52 Mcum) at 50% dependability."

The water available from the Mahadayi River Basin 458. within the State of Karnataka, i.e. from the catchment area of 375 sq.km., has been estimated by Prof. A.K. Gosain, expert witness of the State of Karnataka. He has estimated the annual gross yield at Goa/Karnataka border based on catchment area proportion with respect to Ganjim for the years 1979-80 to 2012-13. From Table 11 at page 9 of Volume 166, the Tribunal notices that the total water available from the catchment area of Mahadayi basin, including its tributaries, within the State of Karnataka, as per the assessment made by Prof. A.K. Gosain, is 43.57 tmc (1234 Mcum) at 75% dependability, and 52.37 tmc at 50% dependability. Prof. Gosain has also estimated, the total water available, from the catchment area of Mahadayi basin, including its tributaries within the State of Karnataka, in his Report of May 2017 (Volume 198). From Table 4, which is at page

10 of Volume 198, the Tribunal finds that the annual gross yield at Goa/Karnataka Border based on catchment area proportion, has been assessed by Prof. A.K. Gosain as 43.20 tmc (1223 Mcum) at 75% dependability and 51.7 tmc (1460 Mcum) at 50% dependability. However, the Tribunal notices that in both the cases, the value of the water availability from the catchment area of Mahadayi basin, including its tributaries, within the State of Karnataka, has been estimated on the basis of the catchment area proportion. The Tribunal further finds that Prof. Gosain has adopted a different approach of assessment of yield of various Project Sites, by using the catchment area proportion as well as the rainfall proportion, and while assessing the overall availability of water from the catchment area of Mahadayi basin in Karnataka, Prof. Gosain has not taken into consideration the variation in the rainfall. This is yet another drawback found by the Tribunal in the Report of May 2017 (Volume 198) submitted by Prof. A.K. Gosain before the Tribunal.

459. Moreover, in this regard, the Tribunal notices that the assessment of water availability from the catchment area of Mahadyi basin, including its tributaries, within the State of Karnataka, is based on the observed Runoff at Ganjim, and

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therefore, the correctness and acceptability of the values of water availability in the catchment area of Mahadayi basin, including its tributaries, within the State of Karnataka, is subject to acceptability of the Runoff Series at Ganjim and the Rainfall-Runoff Equation developed for catchment up to Ganjim.

460. The Tribunal finds that Prof. A.K. Gosain's Study of September, 2015, actually is not a self-contained or independent yield study at all. Prof. Gosain has accepted from CWC study, the Rainfall Stations as selected by CWC. The Thiessen polygon and the Thiessen weights, as well as processed Rainfall data up to year 2000, and computation of non-monsoon contribution, have been taken by Prof. Gosain, while preparing his Study of September, 2015. Thus, the same data was adopted without its critical examination. All that Prof. Gosain has done is that he has added Rainfall and Runoff data for 12 more years, from 2001 to 2012, and has reworked the arithmetic. However, as stated in his report, for derivation of Regression Equation, he has rejected the data for the years, where the runoff factor is more than 1.0, as against 0.9 by CWC. This study is not capable to stand on its own and cannot be described as an independent Study of Prof. Gosain. In fact, the Tribunal finds that basically a few cosmetic

changes have been made in CWC (2003) Study, to pass it off as that of Prof. A.K. Gosain's Study. Prof. Gosain has borrowed from CWC study, almost all the data, without caring to find out as to whether what he was adopting, was correct or not. Therefore, obviously mistakes, such as 2874 mm repeating 14 times in the data of Mapuca, or the errors in determination of non-monsoon contribution, has escaped the notice of Prof. Gosain, or he has ignored the same, because he had to produce the result that 'agrees' with the CWC.

461. The most objectionable part of the Study of Prof. A.K. Gosain is the manner, in which he has handled the data of Castlerock Station. It has been pointed out to the Tribunal by the State of Goa, that the data of Rainfall Station of Castlerock, for the period up to 2000, is suspect and seems to be very much on the lower side. The Tribunal finds that the data for all the years up to 2000, is consistently low, and therefore, consistency checks applied by the CWC to the data up to 2000 only could not have detected anything being amiss. Prof. Gosain has extended this data from 2001 to 2012 and the Tribunal finds that there is a marked discontinuity in the data of Castlerock for the years 2000-2001, and data from 2001 to 2012. This discontinuity in the data

ought to have been detected by Prof. Gosain, and in fact, he did detect the same, and on finding that the data is inconsistent, and that it will have to be rejected, he has taken care to see that it is not properly projected before the Tribunal. The Tribunal notices that the witness has drawn, the double mass curve only up to the year 2000, and thereby has not allowed the inconsistency to surface. Another objectionable part of the Study of Prof. Gosain is, his method of handling of the outliers, that is, years to be excluded, when deriving the Regression Equation. The Tribunal notices that CWC has excluded the years with runoff factors, exceeding 0.9, but, Prof. Gosain, after repeatedly emphasizing that the CWC's procedures are standard, and after asserting that he has followed the same, he has only added some more years data, and has quietly taken into consideration the data of the years with runoff factors up to 1.0. The Tribunal finds that Prof. Gosain has taken into consideration that part of CWC (2003) Report which was convenient to him, and which suits the purposes of the State of Karnataka.

462. According to Prof. Gosain he had derived the Regression Equation by excluding the data for years, where the runoff factor exceeded 1.0. This derivation of the Regression

Equation is estimated by Prof. Gosain at least on three occasions. In para 7.4.2 at page 43 of his Report, Prof. Gosain states that "The years which showed runoff factor of more than 1.0 have been excluded". In reply to question No.179, he has reiterated this by stating "Therefore, in this procedure, as per the practice, only runoff factors, which are more than 1.0, are ignored, and is presumed, that the other factor will compensate each other". From the later part of the above quoted sentence, it becomes very clear that it was his considered decision to retain the data for the years where the runoff factors were less than 1.0 and he expected that these factors, which were less than 1.0, to compensate some other years. The Tribunal finds that to remove any further doubts, he had reiterated this yet again, in his reply to question No.187, where he had stated "As far as my above referred equation is concerned, it has been derived by ignoring all the years with the runoff factor more than 1.0".

463. The Tribunal finds that derivation of Regression Equation is a statistical procedure without involving principles of hydrology. For the purpose of water availability assessment, the preparation of time series of runoff and the weighted rainfall over the catchment to be used for development of rainfall-runoff

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relation is the major task. After that it is statistical analysis, and any person taking the runoff and the concurrent weighted rainfall data from Prof. A.K. Gosain's 2015 Study, and excluding the data for the years with runoff factor more than 1.0, can obtain, the same Regression Equation, as obtained by Prof. Gosain. The Tribunal notices that the State of Goa tried this and got a different Equation.

464. This aspect of the matter was put to Prof. Gosain in question No.187, and he was requested to demonstrate as to how he had got the Regression Equation: Runoff = 0.7368*Rainfall + 432.28. The Tribunal notices that the witness totally failed to demonstrate as to how he had got the Regression Equation mentioned above. Instead of giving a straight answer, he stated that after one does not use the proper information, while deriving the R-R Relation, one is bound to get different equation. In answer to question No.193 put by the Tribunal to Prof. Gosain, he stated as under:-

"On being asked to demonstrate the working of the regression equation in my Report of September, 2015, I explored the computation during the lunch time, and found that while making the computations for arriving at

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R-R relationship, the data of one year namely 1979-80, inadvertently got missed. Therefore, the R-R relationship that was obtained and presented in my Report of September, 2015, is different from the one which would emerge by adding the data of years 1979-80. The equation with this year incorporated would become:-RO = 0.731 *P + 450.77."

465. As a part of this reply, he also handed over a computation, titled "RR-2012_Given", which contained his data and arithmetic used by him. Prof. Gosain has commented, on the question of RO = 0.731 *P + 450.77 and stated that "Although the equation looks different in terms of its value, but it will have a very fractional difference in the final yield, which has been obtained in my September, 2015 Report." The Tribunal notices that at that point of time, Prof. Gosain had not taken the computations to the end using his new regression equation but obtained the aimed results, by using his new Regression Equation, and therefore, the Tribunal finds that, his statement, that it will have a very fractional different on the final yield, is just a fond hope on his part.

466. The Tribunal finds that what will be the yield with the equation: RO = 0.731 *P + 450.77, is immaterial, because that

equation is incorrect. Prof. Gosain, with the equation using data from "RR-2012_Given" and following his logic, the State of Goa tried to verify the new equation offered by him and the said equation could not be obtained by the State of Goa, because there were, obviously, more errors. The Tribunal further notices that Prof. Gosain has excluded the data for the year 2006, despite the Runoff factor for the said year is less than 1.0 and he has changed the Runoff for the year 1998 from 3258 mm to 3219 mm, without assigning any cogent reasons.

467. All this was put to Prof. Gosain in question No.207 when he was asked to explain as to why the data for the year 2006 was excluded, and why the Runoff for the year 1998 was arbitrarily changed by him, and why all these facts were not brought to the notice of the Tribunal, while replying to earlier questions, which were put to him, in relation to derivation of Regression Equation.

468. The Tribunal notices that Prof. Gosain admitted that he had excluded the data for the year 2006, and that he had changed the Runoff data of the year 1998. He stated that "As far as the value of gross yield of the year 1998, being put as 3219 mm, against 3258 mm, at this juncture, it appears to me as a typographical error." The Tribunal is of the firm opinion that this explanation of Prof. Gosain is not convincing at all and has been mentioned as an after-thought. The reason is that one, who knows how Excel spreadsheet is used, knows that once data is entered and checked, it is copied as columns and rows. On first page of "RR Given", there are three Tables, and the right-most Table, where the data is incorrect and the right-most table, where data is found to be incorrect, by the Tribunal, is obtained, simply by making a copy of the Table in the middle and by deleting from it, the data from the certain cells. The Tribunal finds that there is no way, that such an exercise can result in a typographical error, in one cell. According to the Tribunal, this is not a typographical error or otherwise but the Tribunal is of the view that the plain simple fact is the equation RO = 0.731 * P +450.77 remains incorrect. Prima facie, the Tribunal is of the opinion that the equation, which is at least correct in arithmetic, can be obtained, only when the data for the year 2006 is included in the Study, and the Runoff for the year 1998 is corrected. Further, the Tribunal finds that the two wrong equations offered by Prof. Gosain, have a large positive intercept, which, in general,

is not acceptable in rainfall-runoff equation derived for monsoon season.

To summarize, the study of Prof. A.K. Gosain in 469. September, 2015, is not found to be an independent study, by the Tribunal. The Tribunal finds that Prof. Gosain has merely reworked the arithmetic of CWC Study, with 12 more years of data. The Tribunal further finds that since Prof. Gosain has used the processed Rainfall data from the CWC Study, his study includes all the errors which are found in the CWC Rainfall data processing. The Tribunal notices that reliance placed by Prof. Gosain on his consistency checks, for acceptance of CWC's misplaced, but has no merit processed data, is not only whatsoever, because he has checked for consistency data, that had already been checked, and had been modified to make it consistent. The Tribunal finds that glaring anomalies, like the value of 2874 mm, appearing 14 times in Mapuca data, was completely ignored by Prof. Gosain. The Tribunal also notices that in Castlerock data, there is material inconsistency for the year 2000-2001, and therefore, Prof. Gosain drew the double mass curve for Castlerock, only for the years 1964 to 2000, so that the inconsistency does not surface or is apparently reflected. The Regression Equation obtained by Prof. Gosain is found to be incorrect, even in arithmetic. Though he was offered the opportunity, Prof. Gosain failed to replace the earlier wrong equation. For all these reasons, the Tribunal is of the opinion that, his assessment of the yield, mentioned in his Report of September 2015 cannot be accepted and is hereby rejected.

As mentioned earlier, Prof. A.K. Gosain, without 470. obtaining any permission from the Tribunal, produced a fresh Study in May 2017, (Volume 198), to give "credence" to his Study of September, 2015, before the Tribunal. It is his case that he had carried out fresh Study in May 2017 (Volume 198) to give credence to his September, 2015 Study. One would need to lend credence, when one finds, that the earlier report of September 2015 was defective and or erroneous. The Tribunal notices that during the cross-examination, no necessity arose for Prof. Gosain to lend credence to his own report of September 2015. The Tribunal finds that production of Study Report of May, 2017 is highly improper. This fresh Study is also not able to stand alone, and thus lacks as an independent study. A scrutiny of May, 2017 Study makes it very clear that it is a re-production of CWC (2003) Study, with the same selection of Stations, the same Thiessen weights, etc. A thing, which is noticed by the Tribunal, is that in May 2017 Study, made by Prof. Gosain, he himself has done the processing of Rainfall data. The Tribunal further notices that he has used the Rainfall data from a different source, and therefore, the processed Rainfall data calculated by Prof. Gosain, is different from the one, used by him, in September 2015 Study. The Tribunal further finds that May, 2017 Report of Prof. Gosain, has resulted in a strange situation, where Prof. Gosain offers two different data values for the rainfall of the same Station, and for the same year. For example, the Tribunal notices that, as far as Castlerock Station is concerned, Prof. Gosain, in his September 2015 Report has stated that at the above said station the rainfall was 1772 mm in the year 1964, but in his May, 2017 Report, Prof. Gosain has stated that it was 6920 mm. This is just an illustration, referred to by the Tribunal. The Tribunal is of the opinion that Prof. Gosain, as the author of his Report of May, 2017, is not sure about the rainfall at Castlerock, and therefore, neither of his reports can be accepted.

471. The Tribunal further finds that the unprocessed IMD data was available, and in answer to question No.98, Prof. Gosain has stated that if the unprocessed IMD data was made available

to him, he can do reprocessing himself and produce the result in the next hearing. Why the unprocessed IMD data, which was available, was not used by Prof. Gosain, has not been explained by him. The Tribunal finds that if Prof. Gosain had used the authenticated IMD data taken from CWC (2003) Report, and had processed it correctly, then the processed data would have been different from one mentioned in CWC (2003) Report. If such an exercise had been undertaken by Prof. Gosain, the results would have not only contradicted his evidence mentioned in 2015 Report and 2017 Study, but also would have demonstrated that the results mentioned in CWC were also wrong. The decision taken by Prof. Gosain to agree with CWC Report of 2003, at any cost, merely because of the stand taken by the State of Karnataka, has vitiated his two Reports.

472. In view of the inconsistencies, drawbacks, limitations and deficiencies, which are noticed by the Tribunal, not only in the testimony of Prof. A.K. Gosain, but also in his two Reports, the Tribunal is of the firm view that his Studies cannot be taken into consideration, for estimating the yield of Mahadayi Basin.

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Evaluation of Oral Evidence of RW-2 Shri A.K. Bajaj for the State of Karnataka

473. Shri A.K. Bajaj, RW2, has deposed before the Tribunal with respect to topic 'Hydrology-Water Balance Analysis'. From his testimony it becomes evident that he was the Chairman of C.W.C. from April 2008 till 31st October 2011 and during his tenure in CWC, he had worked on and examined many Inter State Water projects. Shri Bajaj has stated in his Affidavit-in-Evidence dated 30th December 2016 that he was requested, by the Water Resources Development Organisation of the State of Karnataka to carry out, a Hydrological Analysis of diversion by the upstream States in Mahadayi Basin which would also include a water balance analysis in the context of trans-basin diversions of the Mahadayi waters to the Malaprabha Reservoir and Kali Reservoir as planned by the State of Karnataka. He has stated that, he has carried out the analysis and is therefore, he is deposing, before the Tribunal.

474. Shri A.K. Bajaj (RW2) filed his Affidavit-in- Evidence dated 30th December 2016. From the said affidavit it is evident that he had conducted a study titled as "Hydrological Analysis of the Diversions and Utilisations by the Upstream States in Mahadayi Basin" which is annexed as 'Annexure A' to his affidavit. In his study, the Tribunal finds that, he has come to the

following conclusions:

- (a) There is a large quantity of water in Mahadayi Basin as estimated at around 200 tmc, by both the CWC and Professor A.K. Gosain of IIT Delhi. Out of this water, the present utilisations of Goa are only 9.395 tmc and the planned utilisations are only 38.53 tmc, inclusive of the present utilisations. For coming to this conclusion, Shri Bajaj has relied upon reply of Goa to interrogatories administered by State of Maharashtra and State of Karnataka which are at Volumes 102 and 103 respectively.
- (b) Even after considering Maharashtra's proposed diversion of 180 Mcum (6.35 tmc), the diversions and utilisations claimed by Karnataka are not incompatible with the planned utilisations by Goa, and in particular the 10 projects in Goa, namely, Sonal I, Surla I, Surla II, Derode I, Mandovi Nanoda, Surla III, Kharmol,

Mayada, Khadki weir and Ganjim weir, which are in the shared catchment for utilisation of 10.59 tmc, are not likely to suffer hydrologically.

- (c) As against the originally estimated inflows which were the basis for the planning of both Malaprabha Reservoir and Supa Reservoir across Kali river, they have suffered acute shortage of inflows into these reservoirs and therefore, diversion of water from Mahadayi, which is in surplus, becomes necessary in the larger interests of the inhabitants of the State of Karnataka.
- (d) The non-utilisation by Karnataka or Maharashtra, as planned, would only result in surplus going to sea.
- (e) The maintenance of natural equilibrium of Mahadayi River in Goa would be wholly inconsistent with the principles of water utilisation and management of the Mahadayi basin.

475. Along with his affidavit dated 30th December 2016, Shri Bajaj has also relied upon, inter alia, the following documents:-

- (a) Hydrological Analysis of Diversions and Utilization by the Upstream States in Mahadayi Basin prepared by him which is marked as EXH. KAR-RW2/1;
- (b) A Map titled as "Projects in Mahadayi basin with shared catchment between the States of Karnataka and Goa" prepared by the office of the Chief Engineer (ISW), Water Resources Development Organization, Bangalore which is marked as MARK-KAR/10.

476. The Tribunal has minutely perused the affidavit in evidence filed by the witness, his cross-examination made by the learned Counsel for the State of Goa and answers given to certain questions which were put to the witness, by the Tribunal, to elicit better information from him. On such perusal, the Tribunal finds many inconsistencies in the evidence of Shri Bajaj which are enumerated herein below:-

- (a) Firstly it is important to note that the witness, Shri Bajaj himself has admitted that he is not an expert in hydrology. He has stated that he does not have a degree in Hydrology, let alone received any formal education on the subject of hydrology. In response to question No.10, asked on behalf of the State of Goa, Shri Bajaj has categorically stated that "I am not an expert on the specific subject of Hydrology".
- (b) Though Shri Bajaj, despite having prepared the water balance study, has not undertaken any site visits i.e. rain gauge Stations etc. in the shared catchment area, as admitted by him in response to QT. Nos. 4 and 5.
- (c) In answer to question No.44 which was asked by the State of Goa, Shri Bajaj has stated that he had merely accepted the findings of Prof. Gosain and Shri Huddar as they have followed the standard procedure of processing the rainfall data, applying consistency checks and thereafter doing regression analysis to work out the yield without applying any other extraneous factor or using the observed data

selectively. From his answer to question No. 44, the Tribunal finds that, Shri Bajaj has not exercised his own judgment and checked the various parameters but has accepted the findings of Prof. A.K. Gosain and Shri Huddar as gospel truth. Shri Bajaj has merely checked the various parameters on the basis of data provided by Prof. Gosain and Shri Huddar and has failed to make his own conclusions on the data of the earlier studies. Further, Prof. Gosain and witness Shri Huddar, have excluded some of the data from consideration and witness Shri Bajaj has failed to satisfy the Tribunal as to why those data were excluded.

(d) When the State of Goa confronted Shri Bajaj, with all the discrepancies in CWC (2003) Report as well as in Shri Gosain's Report, it becomes at once, evident that, Shri Bajaj was not even aware of the details contained in the Report, even though he has heavily relied upon both the Reports. This position becomes clear from answers given by Shri Bajaj to question Nos. 31 to 33, 41, 76, 77, 80, 92-93, 105, 106 and 107.

- (e) Further, a reading of the response to question No. 95 asked by the State of Goa to the witness, makes it more than clear that Shri Bajaj has admitted that based on his Report, it is not possible to prove that the Malaprabha Basin is a deficient basin. The Tribunal finds that, his study was limited to the basin area upto Malaprabha Dam, and not of the Malaprabha Basin as a whole. Therefore, the Tribunal is of the opinion that the State of Karnataka, has been unable to prove through the evidence of Shri A.K. Bajaj that the Malaprabha Basin is deficient.
- (f) The Tribunal finds that when Shri Bajaj was confronted with the errors and flaws in the computation of the yield of the Malaprabha River and also the planning and formulation of the Detailed Project Reports for Malaprabha Reservoir, he was unable to provide the Tribunal with any reasonable Instead of giving any reasonable justification. justification, the errors and flaws pointed out to him were merely denied by him, without assigning reasons.

- (g) In response to question No. 84 (b), Shri Bajaj was confronted with the large scale sugarcane cultivation undertaken in the State of Karnataka. Shri Bajaj has admitted that sugarcane crop pattern were not even considered in his Report submitted before the Tribunal. Thus the Tribunal finds that when such integral topics are not taken into account, then the entire study does not project a clear picture and looks tailor-made to suit the needs of the State of Karnataka.
- (h) In response to question No. 108, Shri Bajaj was confronted by the State of Goa with the proposal to utilize the waters of Bennehalla Nalla which was prepared by Shri Sudheer Sajjan who is/was an engineer with the Water Resources Department of Government of Karnataka. The proposal is marked as Annexure-D to the additional affidavit of Examinationin-Chief of Shri Chetan Pandit and is to be found at Page 146 of Vol.192. In this proposal Mr. Sajjan has estimated the yield of Bennehalla Nalla as 10.92 tmc at 75% dependability, of which, as per the said

proposal, hardly 1.5 TMC has been put to use. The Tribunal finds that Shri Bajaj acknowledged the same but despite having been given ample opportunity, he refused to sufficiently justify as to why, the waters of Bennehalla Nalla was not considered by the State of Karnataka as an available water resource.

- (i) The Tribunal also finds that throughout his study, Shri Bajaj has, at no point of time, taken into account any environmental flows whatsoever, which should have been actually integral part of his study.
- (j) Further, in response to questions No. 58 and 61, Shri Bajaj admits to the casual approach of the State of Karnataka, in respect of environmental needs and concerns and mandatory licenses and clearances, despite the fact that every State is required to obtain clearances etc. under the law. In fact, in response to question No.58, Shri Bajaj has categorically stated that no State can take up any water resources project, unilaterally on any inter-State rivers, without proper clearances from the Central Government on all

aspects including clearance of the inter-State matters. This statement goes against the very basis of the case put forth by the State of Karnataka.

(k) The Tribunal also finds that Shri Bajaj could not provide to the Tribunal, explanation of any kind, when the Tribunal asked him question No.3 about the reason for his suggestion that if the surplus water is not transferred, it will flow unutilized into the sea. Therefore, in the absence of any reasoning to support the same, the Tribunal finds no merit in this suggestion of Shri Bajaj.

477. The answer given by the witness to question No. 36 of the Tribunal, was that the existing water uses for irrigation etc. had to be protected while framing revised DPR, and it was not possible to divert water from there for the drinking water requirements. The witness further stated that he was not in a position to say why only 0.201 tmc had been provided for drinking water, as this decision was taken by the Project Engineer, while framing the revised DPR.

478. The casual and indifferent approach adopted by the witness Shri Bajaj becomes evident if one peruses the question Nos. 32, 33 and 34 put to the witness by the learned Counsel for the State of Goa and answers given by him to those questions. The question Nos.32, 33 and 34 and answers thereto are reproduced for ready reference, which are as under:

"Q.No.32. The question asked to you at serial No. 31 was as regards the runoff at Ganjim exceeding the monsoon rainfall for 4 out of the 5 years, and whether this phenomenon is acceptable to you. The question was not regarding your agreeing with Prof. Gosain or not. Will you please answer the question appropriately, as posed to you?

Ans. Yes, the phenomenon of runoff exceeding the rainfall is acceptable to me.

Q.No.33. What are your reasons for accepting this phenomenon or for agreeing with Prof. A.K. Gosain in this regard? Can you produce authentic literature with scientific basis about the acceptance of such a phenomenon?

Ans. While working as Chairman, CWC, I have had to rely on the Reports and facts and figures put up before me by the relevant experts in the field. I did not have to personally cross check the material placed in these Reports. That is why, in this case also, Prof. Gosain being the expert in Hydrology, I have accepted his Report. Even

I, after working for nearly 4 decades in the Water Resources Field, cannot claim to be an expert on everything. However, the requested authentic literature with scientific basis can be produced by me during the next date of hearing.

Q.No.34. Your answer to the preceding question only shows that, as the CWC Chairman, you were accepting whatever was put up to you, without verifying or crosschecking the same. That may be so, when you were the Chairman, CWC. Today the questions are being asked to you by virtue of your being cited as an Expert Witness in the field of Hydrology by the State of Karnataka and for this reason you have been administered the oath also. I again ask you to answer the questions posed to you in the two earlier questions namely question Nos. 31 and 32 as regards the reasons for accepting this phenomenon. When the runoff is more than the rainfall, it is obvious that there has to be some extra source of water. Please explain, what are those extra sources of water for these particular years, as posed in question No.31, over and above the rainfall?

Ans. Hydrology and hydrological flows are a complex phenomenon. There is a continuous infiltration and regeneration from the ground water below the river bed. This also changes from season to season and the phenomenon of sometimes the runoff being more than the rainfall can occur."

479. The above stated answers make it clear that as Chairman of CWC, he had relied on the reports and facts and

figures put up, before him by the relevant experts in the field and that he himself had never taken the trouble to personally crosscheck the material/analysis/particulars/statements made, in those reports, to verify, whether the facts were correctly mentioned or whether the analysis made in those reports were based on well established principles of hydrology or not etc. He has not mentioned, as to why and for what reasons, he had decided to accept the report of Prof. Gosain. The witness had never noticed that the runoff was more than the rainfall. Thus Annexure-A to his affidavit dated 30.12.2016, which is a hydrological analysis of the diversion and utilization by the upstream States in Malaprabha Basin, can hardly be relied upon by the Tribunal.

480. In the light of the above discussion, the Tribunal is of the opinion that the evidence tendered by Shri Bajaj, on behalf of the State of Karnataka cannot be relied upon, since it is wholly inconsistent with the case put forth by the State of Karnataka. In fact, the Tribunal observes that the answers given by Shri Bajaj in his cross-examination, disprove to some extent, the case put forth by the State of Karnataka. The study undertaken by Shri Bajaj is deficient and incomplete. The study of Shri Bajaj, thus suffers from several draw-backs and limitations. The statements made by the witness in his affidavit and answers given by the witness during the course of his cross-examination, make his testimony unworthy of acceptance. Under the circumstances, the Tribunal is of the view that it would not be safe to place any reliance on his testimony relating to subjects, on which he has deposed.

Evaluation of Oral Evidence of MW-1 Shri S.N. Huddar for the State of Maharashtra

481. Shri S.N. Huddar, MW1, witness for the State of Maharashtra, has deposed before the Tribunal, with respect to the topic, 'Hydrology and Availability of Water'. From the data furnished by Shri Huddar, in his Affidavit, it becomes evident that, he had occupied the post of Secretary (CAD), Water Resources Department, Government of Maharashtra, Mumbai and then, had retired in 2006. The data also indicates that he had also worked as an Assistant Director in the Central Water Commission from 1975 to 1976. His data would show that, he was also appointed by the Government of Maharashtra as an Advisor, on the matters related to the Krishna Water Disputes and for obtaining clearances to the various irrigation projects of

Maharashtra. As stated in his Affidavit, in August, 2015, he was requested by the Government of Maharashtra, to study, water availability in the Mandovi Basin and depose before the Tribunal, with regard to the State of Maharashtra's case for water availability, in the Mandovi basin as well as the State of Maharashtra's contribution in the Mandovi basin. From the averments made in his Affidavit, it is evident that Shri Huddar is also currently working as an Advisor, to the Government of Maharashtra, in the matter of, the Inter-State Water Disputes, with regard to the Mahadayi River.

482. Shri S.N. Huddar has filed his Affidavit-in-Evidence, before the Tribunal on 13.09.2015, on the topic of "Hydrology and Availability of Water". Shri Huddar has also conducted a study on availability of water in the basin and has come to the following conclusion:-

"...I consider 5913 Mcum as the water availability in entire Mandovi basin including import component as water availability plus return flows to be evaluated, as the water availability from Mandovi basin for allocation purpose". 483. The witness has stated that the allocation of water of Mahadayi River Basin should be decided at 75% dependability. The Tribunal finds that Shri Huddar has added the import of water, from the Tillari Basin, in his calculations, of water availability, for which he has relied upon, the Krishna Water Disputes Tribunal's decision. However, the Tribunal finds that in the present case, there is already an agreement between the State of Goa and the State of Maharashtra, with regard to the Tillari Basin.

484. Along with his Affidavit dated 13.09.2015, Shri Huddar has relied upon the following documents:-

- (a) Annexure 1 to the Affidavit:- "Note on study about yield of Mahadayi basin out of Central Water Commission in March 2003" prepared by Shri Huddar.
- (b) Annexure 2 to the Affidavit:- An agreement between the State of Maharashtra and State of Goa for execution and management of Tillari Irrigation Project dated 06.04.1990.

- (c) Annexure 3 to the Affidavit:- Government of India, Central Water Commission, Project Appraisal Organization dated 19th December, 2009 dealing with the subject of 101st meeting of the Technical Advisory Committee (TAC) held on 30.11.2009.
- (d) Annexure 4 to the Affidavit:- Tillari Inter-State Irrigation Project, dated 12.09.2015 dealing with Water Assessment of Goa State in Tillari (Chapora) and Mahadayi basin (colly.).
- (e) Annexure 5 to the Affidavit:- Assessment of Water
 Availability in Maharashtra Catchment Area in
 Mandovi Basin.

485. Shri Huddar was cross-examined on behalf of the State of Goa, by Shri Dattaprasad Lawande, learned Advocate General of the State of Goa, with regard to his Affidavit-in-Evidence and the documents produced by him.

486. The Tribunal has perused the Affidavit-in-Evidence dated 13.09.2015 of Shri Huddar, along with his cross-

examination. The Tribunal finds that, there are some parts of his own study, which he has not been able to substantiate and explain. Further, certain other inconsistencies, which are reflected in the study, conducted by Shri Huddar, are noticed by the Tribunal. They are as under:-

(a) A reading of the responses of Shri Huddar to question nos. 1, 3, 4, 5 and 10 asked to him, by the learned Counsel for the State of Goa, shows that Shri Huddar has merely carried out a checking of the R-R equation of CWC. The Tribunal notices that, in fact, in response to question No. 4, Shri Huddar has admitted that he has not fully scrutinized all the parameters of the CWC Report and had only looked at the rainfall-runoff equation. Thus, it is apparent that, he has merely taken into consideration, only the CWC Report and has estimated yield to be 5652 Mcum at 75% dependability. In response to question No. 18, Shri Huddar has admitted that, besides checking out R-R equation of CWC, he had not checked any other computations provided in the CWC Report. The response given by Shri Huddar, leads the Tribunal to

come to the conclusion that Shri Huddar, has not conducted any independent study, but has only checked the aspects of rainfall runoff equation of the CWC Report. It is clear from his testimony that he has accepted all the parameters as adapted by CWC and has followed them blindly, without performing any sort of checking whatsoever.

The Tribunal further finds that in answer to question (b) No. 13, Shri Huddar has stated that the gauge data, which was supplied to him, was subjected to various checks by the Chief Engineer, Hydrology Project, Nasik and, therefore, he has not checked this data himself. In his response, to question No. 5, asked by the Tribunal, he has admitted, to not having checked the consistency data of Ganjim site of CWC using the Virdi gauging station data. This is important when witness Shri Huddar has admitted to not having checked the data particularly with reference to Virdi data for the purpose of external consistency checks and merely having taken the data, which was provided in the CWC Report. It is for these reasons, inter alia, that the Tribunal finds that Shri Huddar has not conducted a study in its true sense, on the availability of water, in the Mahadayi River Basin.

(c) The various discrepancies in the CWC Report were brought to the notice of Shri Huddar, when he was put questions No. 20 & 21, during his cross-examination, by the learned Counsel for the State of Goa. The Tribunal notices that Shri Huddar has, in fact, admitted to all these discrepancies and the only explanation offered by him is that the discrepancies mentioned in guestions Nos. 20 & 21, are not serious enough to affect the yield figure worked out by him. The Tribunal is of the opinion that the answer given by Shri Huddar is not convincing at all. The Tribunal finds that Shri Huddar was aware of these discrepancies and, therefore, he should have either rectified the same or should have clearly shown that these discrepancies are not serious enough to affect the yield figure. What the Tribunal finds is that, no reasons have been given by Shri Huddar as to why the

discrepancies pointed out to him are not serious enough to affect the yield figure worked out by him.

- (d) A bare reading of answers given by Shri Huddar to questions No. 9, 24 and 26, put by the learned Senior Counsel for the State of Goa, shows that Shri Huddar has contradicted his own statement made about the smaller catchment having a larger run-off, when he was asked to explain the same in light of discharge data of Virdi and Ganjim. The Tribunal notices that Shri Huddar was unable to, fully explain the same in detail, which in turn leads the Tribunal to record a conclusion that Shri Huddar has not assessed and performed any checks, on the Ganjim data.
- (e) The Tribunal finds that Shri Huddar has excluded data of some years while computing the yield. With reference to the said exclusion, question No. 28 was put to him by the learned Advocate General of the State of Goa. In response, the witness has stated that, the data of 9 years was excluded since it was not within the acceptable range of runoff, which according
to him, was 0.65 to 0.9. The Tribunal notices that, except making a bald statement, no reasons are provided by the witness to the Tribunal, as to why the data of 9 years was found to be not within the acceptable range of runoff. The Tribunal further notices that when the witness was asked question No. 30, by the State of Goa, as to why he had included data of 10 years, even though that too was not within the acceptable range, the witness gave a very vague answer by stating that the same was also done by CWC. Under the circumstances, the Tribunal is left with no option, but to record a finding of fact that the entire study, conducted by Shri Huddar is merely in line with the CWC Report, since, all the the parameters mentioned in the CWC Report, are merely accepted by the witness, without scrutiny of any kind.

(f) The Tribunal further notices that in response to question No. 10, Shri Huddar has admitted that he arrived at the figure of 5913 Mcum, by adding 261 Mcum, which is the import of the Tillari Irrigation Project, to the figure of 5652 Mcum, which is the water availability worked out at 75% dependability, assessed by CWC. The Tribunal also notices that in response to question No. 14, Shri Huddar admitted that the study was not for the quantum of utilizable water. The Tribunal is of the view that once the quantum of utilizable water is excluded from consideration by Shri Huddar, the whole purpose for which Shri Huddar was engaged to undertake a study stands defeated.

487. In the light of all above, the Tribunal finds that Shri Huddar has not conducted any independent study, but, has merely conducted a checking of the CWC Report without even scrutinizing it completely. As admitted by Shri Huddar, the Tribunal finds that the figure of 5913 Mcum is arrived at by Shri Huddar, by adding 261 Mcum, which is the import of Tillari Irrigation Project, to the figure of 5652 Mcum, which is the water availability at 75% dependability, as assessed by CWC. Therefore, the Tribunal finds that the evidence tendered by Shri Huddar, on behalf of the State of Maharashtra, cannot be relied upon.

Evaluation of Oral Evidence of AW-2 Shri Paresh Porob for the State of Goa

488. Mr. Paresh Porob has deposed on behalf of the State of Goa, especially on the Wildlife and Forest, which can and likely to be affected within the region of flow of river Mahadayi and its allied water types. Mr. Porob has extensively worked as a Range Forest Officer in Madei Wildlife Sanctuary and has observed and studied wildlife in the natural resources of Goa many times, using modern technology. In his two affidavits, he has elaborated on how the forest in water flow due to (a) abstraction of water, (b) diversion of water, will influence the bio-diversity, botanical and zoological diversity in the State of Goa. His affidavits are premised on the fact that if the proposed project for water diversion of Mahadayi river is allowed and effected, it will be harmful for the ecology. It will affect the wildlife sanctuary and will defeat the purpose of the National Forest Policy, 1988, as also will be in contravention of certain provisions of Wildlife Protection Act. Mr. Porob has identified Mahadayi river and Surla river as the two prominent source of water which sustain the vast bio-diversity of the Wildlife Sanctuary and Parks of the State of Goa. According to him, while the catchment area from the Mahadayi river flowing areas is larger at approximately 206 sq.km., the catchment area which sustains bio-diversity through Surla river is smaller area of approximately 75 sg.km. Mr. Porob has specifically stated that two rivers merge in Zone 2 of the three different Zones which are marked under ecological classification for the State of Goa. The crux of his affidavit, inter alia, is that if the flow of Mahadayi river is diverted/ abstracted, Surla river alone will not be sufficient to sustain the ecology of these Wildlife Sanctuaries and western Ghats, which are classified as one of the "Hottest Hotspots" in the world, will suffer irreversible damage. On the basis of certain Annexures annexed with his additional affidavit, he has also quantified the bare minimum requirement of fresh water, which is necessary to sustain the ecology in the Wildlife Sanctuaries and National Parks of Goa. Mr. Porob has also specifically pointed out that while water fed through the river is plenty during the monsoon season, as the monsoon progressively approaches the animals come to rely more frequently on the watering hole, across the Wildlife Sanctuary and Parks. As the watering holes start drying towards the end of pre-monsoon cycle of the next year, they are again reflecting with the onset of monsoon and increases the flow of the rivers. According to him, if there is abstraction/ diversion of

water, the availability of water will become scare for all animals, thereby adversely affecting their population.

489. Mr. Porob, has mentioned that, the total 17 water holes have been established in Madei Wildlife Sanctuary, which are fed by the water coming from river Madei, during summer. The total quantum of water, in these water holes, are shown by him in Table 1.3 at page 15 of Volume. 214. The same reads as under:-

Table No.1.3 below, shows the demand for Wildlife. Management in Mahadayi Basin is enumerated as below:-

FOREST	PRESENT WATER	WATERHOLES AND
	HOLES AND QUANTITY	THEIR QUANTITY
	OF WATER	ENVISAGED BY 2050
Madei Wildlife	17	40
Sanctuary	(17x300 = 5100 Cum)	(40x300=12000 Cum)
Bhagwan	13	48
Mahavir Wildlife	(13x300=3900 Cum)	(48x300=14400 Cum)
Sanctuary		
Bondla Wildlife	8	8
Sanctuary	(8x300=2400 Cum)	(8x300=2400 Cum)
Total	11400 Cum	28800 Cum

490. In paragraph 15 of his additional affidavit dated 17th November, 2017, Mr. Porob has summarized all his statements.

491. This witness was cross examined by the learned Counsel for State of Karnataka. In response to question No.3, as to whether the witness has conducted any scientific study on the quantification of water requirement and forest, flora and fauna and the water requirements of villages in Surla valley and Kodval valley, the witness has answered the question by stating that he has not conducted such a study. In the additional affidavit filed by the witness on 17.11.2017, the witness has mentioned the quantity of water required in Table No.1.1 as 1804.336 cum (63.72 tmc), in Table No.1.3 as 28800 cum (0.001 tmc), whereas in Table No.1.4 quantity of water required is stated as 120000 cum (0.004 tmc), totaling 63.725 tmc, but no record in support of the criteria, is disclosed. Therefore, it was put to the witness that these self-serving calculations are merely ipse-dixit without any record of scientific study, and the learned Cross Examiner had sought response from the witness.

In answer, the witness denied the suggestion. According to him calculations given in the tables 1.1 and 1.4 were taken from

Water Resources Department of the Sate of Goa, whereas the scientific observations made by him, on day-to-day basis, on inventory of amphibian fauna of Surla and Kodval Valley, were recorded to understand the existence and dependability of this Fauna in Madei Wildlife Sanctuary. The witness had further stated that reduction of any amount of water, in both the valleys will result in endangering and extinction of local species of frogs known as Nyctribatricus.

492. The learned Cross Examiner for the State of Karnataka requested the witness to refer to Volume-I of the Master Plan of Mahadayi/Mandovi river prepared by the Irrigation Department of Government of Goa and turn to page 55 and informed the witness that in para 5.6.4, the requirement of water for different uses in Mahadayi Basin up to 2050 and are calculated and at serial No.4, 50 Mcum (1.765 tmc) is mentioned against forest management, whereas in additional affidavit, the witness has claimed that, the water requirement of 0.001 tmc in table No.1.3 and 0.004 tmc in Table No.1.4, are required. Further his attention was drawn to the Master Plan, wherein it is mentioned that 158 Mcum (5.579 tmc) is required for salinity control, and thus the total water requirement for forest management, comes to 7.344

tmc. Therefore it was put to the witness that if this quantification of water requirement of 7.344 tmc were to be maintained or ensured for meeting the forest management and salinity control, there would not be any adverse impact or damage to the environment and ecology in Goa. After putting the aforesaid suggestion the response of the witness was sought.

The witness denied the suggestion and stated that the quantity mentioned in the Master Plan at page 55 para 5.6.4, referred to in the question, is for forest management at serial No.4, and it should be noted that while preparation of Mater Plan, forests are taken into consideration, since Madei Wildlife Sanctuary was not notified at that point of time, the requirements of water for Wild Life and habitat maintenance, was not considered. The witness further explained that Tables 1.1 and 1.3 mentioned in his additional affidavit, show the quantum required directly by forest components of Wildlife Sanctuary.

493. The attention of the witness was drawn to para 33 of his affidavit dated 11.11.2017 (Volume 209) and it was put to the witness that on the one hand he has stated that the Madei

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Wildlife Sanctuary has threatened species of birds, and on the other, the very document relied upon by him clearly shows that main threat to the bird heritage and flora and fauna in the Madei Wildlife Sanctuary, is human encroachment and mining, and therefore, the witness has selectively relied upon the article to show the proposed diversions of the Karnataka Government, which are likely to impact, on the forest of Mahadayi valley, but conveniently he has not adverted to, the preceding part of the article. After putting the suggestions, the response of the witness was sought by the learned Cross Examiner on behalf of Karnataka.

The witness, first of all, denied the suggestions and stated that it should be noted that there is no mining activity within the jurisdiction of Wildlife Sanctuary in Goa and hence effect of any such mining activity on avifauna in Wildlife Sanctuary is not there at all, whereas river diversion projects are upstream of Wildlife sanctuaries in Goa and also on upper stream of Bhimgarh Wildlife Sanctuary of Karnataka, which act as a Wildlife corridor for unhampered movement of macro-Fauna. The witness has asserted that any activity in upper stream, will result in disturbance to the habitat of avifauna and Gene-Pool conservation will be, greatly affected.

494. Thereafter, Shri Mohan V. Katarki, the learned Counsel for State of Karnataka closed his cross-examination. Therefore, Shri D.M. Nargolkar, the learned Counsel for State of Maharashtra was requested to cross-examine the witness on behalf of the State of Maharashtra. In all the learned Counsel had put six questions to the witness, and question No.6 was as to whether the witness agreed that any sort of diversion or utilization by any of the States, including the State of Goa, in future, in Mahadayi Basin, would result in adverse impact and would disturb the ecological balance, resulting in total disaster in Mahadayi Basin.

The witness stated that he agreed with what was stated in question No. 6.

495. After the cross-examination of the witness, by the State of Karnataka was over, Shri Atmaram N.S. Nadkarni, the learned Senior Counsel for State of Goa stated that he did not want any opportunity to conduct any re-examination of this

witness. Therefore few questions were put to the witness by the Tribunal to elicit certain information relating to Wildlife etc. The attention of the witness was drawn to what he had stated in para 13 on page 10 of his affidavit dated 11.11.2017, and the attention of the witness was also drawn to MARK GOA-16 (Colley), as well as National Forest Policy 1988, and witness was requested to inform the Tribunal as to whether he had examined the social and environmental costs and benefits, before arriving at the conclusion that if proposed project for diversion of Madei river water was allowed, it will be harmful to the ecology, and that it will also adversely affect the Wildlife Sanctuaries and in general defeat any principle of the National Forest Policy 1988.

In response, the witness stated that the Government of Goa has notified Forest Wildlife Sanctuary along the stretch of Western Ghats of Goa, for water security and maintaining ecological balance. According to the witness socio-economic conditions of the inhabitants of these areas are depending on the Western Ghats in Goa, and in his earlier affidavit dated 11.11.2017 at para 46 on page 27 he had stated about man animal conflict and its implications on the socio-economic conditions of the people. The witness proceeded to state that the water flowing out from Wildlife sanctuary is being utilised by people for cultivating which is a traditional practice and that is mentioned by him in para 55 on page 31 of his affidavit dated 11.11.2017.

496. The attention of the witness was drawn to para 4.4.1 of the National Forest Policy 1988, and witness was asked as to whether any forest land been diverted from any non-forest purpose, either by the State of Goa or by the State of Karnataka. Another question which was asked was as to whether the diversion of forest land for non-forest purposes had resulted in any change, either increase or decrease, in the water availability, and how many projects related to dams and reservoirs, mining and industrial development, and expansion of agriculture, have been constructed in forest areas and how the availability of water has been impacted, as well the result of implementation of such projects.

The witness answered that he was not knowing if the States of Karnataka and Goa have diverted any forest land for nonforest purposes. The witness further stated that he did not know as to whether the diversion of any forest land for non-forest purpose has resulted in any change in the water availability, and finally he replied that he was not knowing about any project relating to dams, reservoirs, mining, industrial development and expansion of agriculture having been undertaken in the forest area, and therefore, he was not able to comment upon the impact of any such projects on the availability of water.

497. It was brought to the notice of the witness that in several paras of his affidavit dated 11.11.2017, he has mentioned about adverse impact of diversion of water from Mahadayi Basin on forest and Wildlife, and his particular attention was drawn to para 54 on page 31 of his affidavit. He was informed that the Tribunal has noticed that the mean of the average monsoon rainfall over the Mahadayi Basin during the years from 1964 to 2005 is 3760.1 mm, and the average monsoon rainfall over the Basin, varies considerably. It was also noticed by the Tribunal that in many years there were considerable variations, in the yield with respect to yield mentioned for in the previous years, whereas there were marked variations in long term as well. Therefore the witness was asked as to whether he had examined the impact of variations in rainfall and consequently in yield from Basin, particularly when the variations were too large, as in the

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year 1971 and 1972, on the forest and wildlife. Another question put to the witness was as to how he predicted disaster for the forest and wildlife because of likely diversion of relatively small fraction of total yield of the Basin.

The witness mentioned that he is not a hydrologist and therefore is not in a position to answer the first question. The witness proceeded to state that as far as forest and wild-life is concerned, any diversion of water coming to the forest will still result in reduction of water and will also reduce water velocity, which in turn, will harm dissolving of minerals and transportation of organic matter from one area to another and that this has been explained in detail, in para 26, on pages 16, 17 and 18, of his affidavit dated 11.11.2017.

498. The Tribunal finds that the veracity/authenticity of the figures relied upon by the Water Resources Department, State of Goa, having not been questioned/challenged or discredited by the learned Counsel for the States of Karnataka and Maharashtra, the reliance of Mr. Porob, on such figures may, therefore, be taken, as correct, for the purpose of his statements. It is pertinent to note that, in answer to question No.3 put by the

Tribunal, the witness has stated that, while preparing his affidavit, he had taken into consideration, provisions mentioned in National Forest Policy, 1988, and the Tribunal finds that, the various aspects mentioned in National Forest Policy, 1988, were taken into consideration by this witness with reference to ecology or the developmental requirements, to be maintained in the States of Karnataka and Maharashtra.

499. In view of the above discussions, the Tribunal concludes that the testimony of this witness, can be acted upon, subject to availability of changes in quantum related information, in other witness's statements/submissions, put forth, on behalf of the State of Goa.