VANSADHARA WATER DISPUTES TRIBUNAL

THE REPORT

OF

THE VANSADHARA WATER DISPUTES TRIBUNAL

WITH THE DECISION

IN THE MATTERS OF WATER DISPUTE REGARDING
THE INTER-STATE RIVER VANSADHARA AND
THE RIVER VALLEY THEREOF

BETWEEN

THE STATE OF ODISHA

AND

THE STATE OF ANDHRA PRADESH

VOLUME-I

(Pages 1-165)

NEW DELHI
SEPTEMBER 2017

COMPOSITION OF

THE VANSADHARA WATER DISPUTES TRIBUNAL

CHAIRMAN

Justice Dr. Mukundakam Sharma
(Former Judge, Supreme Court of India)

MEMBERS

Mr. Justice B.N. Chaturvedi
(Former Judge, Delhi High Court)

Mr. Justice Ghulam Mohammed
(Former Judge, Andhra Pradesh High Court)

ASSESSORS

1. Mr. A.D. Bhardwaj
(Former Member,
Central Water Commission,
Ministry of Water Resources,
Government of India)

2. Mr. M.S. Agrawal
(Former Chairman,
Godavari River Management Board,
Ministry of Water Resources, RD & GR,
Government of India)

Representatives of the State Governments before the Vansadhara Water Disputes Tribunal

1. **For the State of Odisha**

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ii. Dr. Rajeev Dhavan, Senior Advocate
iii. Mr. Raju Ramachandran, Senior Advocate
iv. Mr. Sambhu Prasad Singh, Senior Advocate
v. Mr. Mohan V. Katarki, Advocate
vi. Mr. Ranvir Singh. Advocate
vii. Mr. Sushil Kumar Singh, Advocate
viii. Mr. R.S. Jena, Advocate-on-Record

Assisted by the following officials and consultants

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ii. Mr. Pradeep Kumar Jena, Principal Secretary to Government, Department of Water Resources
iii. Smt. Usha Padhi, Additional Secretary
iv. Smt. Debjani Chakraborty, Additional Secretary
v. Smt. Chithra Arunmugam, Special Secretary to Government, Department of Water Resources
vi. Mr. Vishal Gagan, Special Secretary to Government, Department of Water Resources
vii. Mr. Harish Chandra Behera, Engineer-in-Chief

viii. Mr. Biren Kumar Sahu, Chief Engineer, PPF & I

ix. Mr. Baidhara Panda, Chief Engineer, PPF & I

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xi. Mr. Manoj Kumar Mishra, Chief Engineer, PPF & I

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vi. Mr. D. Rama Krishna, Chief Engineer
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vii. Mr. P. Ramakrishna Murty, Chief Engineer

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x. Mr. B. Venu Gopala Chary, Superintending Engineer

xi. Mr. T. Giridhara Rao, Deputy Director (VT)

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xiii. Mr. N.V.S. Raju, Deputy Director

xiv. Mr. L.V. Ramana Murty, Deputy Director

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xxi. Smt. K. Santhi Shobha, Assistant Executive Engineer

xxii. Smt. P. Veeramma, Assistant Executive Engineer

xxiii. Prof. K.G. Ranga Raju, Hydraulic Engineering Consultant

3. For the Central Government

Advocate

Mr. Wasim A. Qadri, Advocate

ABBREVIATIONS USED

AP/A.P.	:	Andhra Pradesh
APW	:	Andhra Pradesh Witness
BL	:	Bed Level
cft	:	cubic feet
cm	:	centimetre
cum	:	cubic metre
cumec, m^3/s	:	cubic metre per second
cusec, c/s	:	cubic feet per second
CWC	:	Central Water Commission
CWPRS	:	Central Water and Power Research Station
d/s	:	downstream
El	:	Elevation
Ex.APW	:	Exhibit Andhra Pradesh Witness
Ex.OW	:	Exhibit Odisha Witness
F.S.L.	:	Full Supply Level
FRL	:	Full Reservoir Level
ft	:	feet
G&D	:	Gauge and Discharge
G.L.	:	Ground Level
ha	:	hectare
HEC-RAS	:	Hydrologic Engineering Cenre – River Analysis System
HFL	:	Highest Flood Level
IMD	:	India Meteorological Department
ISRWD Act	:	Inter-State River Water Disputes Act
KM, Km, km	:	kilometre
L.B.	:	Left Bank
m	:	metre
M.cft	:	million cubic feet
M.S.L.	:	Mean Sea Level
m/s	:	Metre per second
$m^3/s/m$	:	Cubic metre per second per metre
mm	:	millimetre
MT	:	Metric Tonne
MWL	:	Maximum Water Level
'n'	:	Manning's rugosity coefficient

OW	:	Odisha Witness
P&P	:	Planning & Progress
RD	:	Reduced Distance
RD & GR	:	River Development and Ganga Rejuvenation
sq km	:	square kilometre
TMC	:	thousand million cubic feet
u/s	:	upstream
WR	:	Water Resources

Note 1. Name of the State as 'Odisha' has also been spelled as 'Orissa' in the report. Both the names have been used for the same State.

2. Name of the river as 'Vansadhara' has also been spelled as 'Vamsadhara' in the report. Both the names have been used for the same river.

3. Name of the place as 'Katragada' has also been spelled as 'Katragadda' and 'Kutragada' in the report. All these names have been used for the same place.

4. The term 'Side Weir' for the Side Weir at Katragadda has also been used in the report as 'Side Channel Weir' or 'Side Weir Channel'. All these terms have been used for one and the same structure, i.e. Side Weir at Katragada.

UNITS AND CONVERSION TABLE

LINEAR

1 cm	=	0.394 inches
1 metre	=	3.281 feet
1 inch	=	2.54 centimetre
1 foot	=	30.48 centimetre

AREA

1 hectare(100 metresx100 metres)	=	2.47 acres
1 acre	=	4840 sq. yards
		0.40 hectares
1 sq. mile	=	640 acres
	=	259 hectares
1 sq. km	=	100 hectares

VOLUME

1 cubic metre (cum)	=	35.315 cu. ft (cft)
1 million cubic metre (MCM)	=	35.315million cubic feet (mcft)
	=	810.71 acre feet
1 cubic feet (cft)	=	0.0283 cum
1000 million cubic feet (TMC)	=	28.32 million cubic metres (MCM)
	=	22957.0 acre feet
1 million acre feet (MAF)	=	43.56 TMC
	=	1234.56 MCM

RATE OF FLOW

1 cubic meter/second (cumec)	=	35.315 cusecs
$1m^3/s$ a day	=	70.05 acre ft/day
	=	8.646 ha.m/day
1 cubic feet per sec (cusec)	=	1.98 acre ft/day

ACKNOWLEDGEMENT

We have completed our task of hearing on the reference made to us by the Central Government. This was indeed an onerous and arduous task but fortunately we have been able to perform the same without any hassle and that also within time. While doing so, we have received help, assistance and support from many quarters and therefore, we would like to acknowledge the same with thanks.

We deeply appreciate the assistance and help rendered by late Shri Anil B. Divan, Dr. Rajeev Dhavan and Shri Raju Ramachandran, the learned Senior Advocates appearing for the State of Odisha at different stages of the proceeding. Shri Mohan V. Katarki, Advocate very admirably conducted the matter for the State of Odisha. Shri C.S. Vaidyanathan, the Senior Advocate and Shri G. Umapathy, Advocate appearing for the State of Andhra Pradesh must also be commended for their able and persuasive advocacy. Mr. Wasim A. Qadri, Counsel of the Central Government also forcefully argued on the issue of maintainability being ably assisted by Mr. Virender Sharma, Senior Joint Commissioner, Ministry of Water Resources, River Development & Ganga Rejuvenation. At the same time, we also acknowledge the assistance provided by all the Associate Advocates who all very painstakingly and with dedication rendered assistance not only to the Senior and leading Counsel but also to the Tribunal.

We appreciate the help and assistance rendered by Mr. A.D. Bhardwaj and Mr. M.S. Agrawal, the two Assessors in assisting us to understand the intricacies of some of the technical issues and also assisting us in writing the technical part of the Report. We extend our thanks and

gratefulness to both of them. Mr. S.K. Sinha, the retired Assessor has made some useful contributions during the hearing of the proceeding and we acknowledge the same. Mr. Dhananjay Kumar, the Executive Engineer of the Tribunal was also of immense help throughout and particularly at the time of writing and finalizing the Report.

The officials of both the States at different stages helped the Tribunal in discharging their duties efficiently and effectively and we also acknowledge herein their help and cooperation.

Our supporting staff namely, Smt. N. Annapurna, Smt. Meera Hemant, Mr. P.S. Chagger, Mr. Ashok Kumar, Mr. K.K. Batra, Mr. S.K. Kathuria and Ms. Sarita Kashyap have ungrudgingly carried out all the tasks assigned to them at different stages very efficiently and competently and we acknowledge their assistance and thank them for their support. Smt. N. Annapurna and Smt. Meera Hemant also, as the Court Masters, carried out their task very efficiently and they deserve special thanks for the same. The present Registrar, Mr. Harish Chander was helpful in all the matters and so was Mr. B.V. Sharma, the former Registrar. Mr. Harish Chander, the present Registrar worked hard to see that the decision could be rendered and the Report could be submitted within the stipulated time.

We also acknowledge the service rendered by the former Chairman, Mr. Justice B.N. Agrawal, retired Judge of the Supreme Court of India, Mr. Justice Nirmal Singh, a retired Judge of Jammu and Kashmir High Court who was a former Member. Although both of them submitted their resignations but they contributed immensely towards working and functioning of the Tribunal and we offer our thanks to them. Mr. D.R. Satia, retired Court Master and Mr. S.K. Dhar and Mr. M.S. Sodhi, both retired Private Secretaries have made

useful contributions to the Tribunal. We must acknowledge that without the cooperation and assistance of the entire team in the office, it would not have been possible to prepare the Report and give the decision within the stipulated time. We also place on record our thanks and gratitude to all the officials and staff of the Ministry of Water Resources, River Development & Ganga Rejuvenation etc. for their co-operation and support accorded to us throughout our assignment. We record our deep appreciation to all concerned and thank them all for their yeoman service and assistance.

Ghulam Mohammed J.
MEMBER

B.N.Chaturvedi J.
MEMBER

Dr. Mukundakam Sharma J.
CHAIRMAN

New Delhi
13th September, 2017

I N D E X

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VOLUME - II

1

INTRODUCTION

1.1 The Indian mind and the Sanskrit literature has always emphasized on five elements called *panchbhutas,* which are air, water, earth, fire and atmosphere (environment). Out of these, two, namely, air and water are the most important elements for survival of the mankind. In absence of clean air and water, the human habitation would not be able to survive at all. Water has been all along considered as an asset and one of the most useful resources. All the civilizations in the world like Indus Valley, Greek, Roman and Egyptian civilizations have their genesis and evolution at places near the banks of rivers as water was considered to be prime constituent of life and was necessary not only for survival of mankind but also for progress, prosperity and development of the society. Although we have water in about three quarters of the earth surface in the form of snow, rivers, lakes, ponds, water bodies and oceans but, such water which could be used for drinking and agricultural purposes would be much less as the water of the oceans is saline water and cannot be used for the aforesaid purposes unless and until it is desalinised. However, the process of desalinisation is also very costly and, therefore, the emphasis is always on the fresh water resources available in the rivers, lakes, ponds and other water bodies.

1.2 The water resources in India are roughly 4% of the world's fresh water resources whereas the population of the country is 16% of the world's population. With the rapid increase in the population,

urbanisation and industrialisation, there is a growing requirement of water, both surface and ground water.

1.3 As India moves forward into the 21st century like other nations in the world, it must prepare itself to adapt to the unique economical, political, societal and environmental challenges that this world is likely to face in the near future. An area of particular concern is the Indian population and its growth which is likely to soon outpace China to render the country as the most populous in the world. With the increase in the population, the need to have various resources like economic, societal and natural would increase several folds. It is, therefore, imperative for the government in power to plan and prepare for the unavoidable tussle for making available the basic limited resources that would arise in the coming decades. The likely impact of climatic change and environmental pollution also looms large over the country, with many visible signs of the ill-effects of environmental degradation already becoming clearer in our towns and villages. Our country has always been facing the problem of drought and flood thereby creating havoc in the life of the citizens. With people using water in a haphazard manner, the ground water level has seen alarming depletion in many parts of our country. At the same time, the factors of global warming and melting of the glaciers which is one of the sources of the origin of some of our rivers, have made the position and the situation more complex. The need of the hour, therefore, is proper planning in management and use of our water resources. Therefore, one of the main thrusts would have to be given to such planning and use of India's water resources for avoiding the scope of possible

depletion and for making it available for its vast population. Being such a unique element to human life, the absence of water leads to an immediate halt to the normal functioning of the society as well as economic activities. It is also said that the cause of the next world war could be water. Therefore, it is imperative for India to secure water resources, both surface water as also the ground water.

1.4 The importance and centrality of water resources has been recognised in India since time immemorial. The Vedas and the Vedangas lay down rules to control pollution and in giving emphasis on having a clear environment and also for maintaining the nature and its resources. In fact, water has always been an essential constituent of rituals and prayers. We worship rivers like the Ganges in some of the most revered places of worship like Varanasi, Haridwar and Rishikesh, which are located near important river front. The medicinal properties of water have always been highlighted by Vedic and Sanskrit literature and at the same time emphasis and stress was given on proper use and importance of conservation and preservation of water resources. Culture and civilization that developed across the length and breadth of our country have for centuries devised their own unique manners through which limited water resources available with us could be properly managed and maintained in a balanced manner.

1.5 In the modern India of today, it is sadly noted that we have lost much of the vigour and fortitude shown by our ancestors when it comes to the management of natural resources. As a result, we have failed to consider the natural consequences of rapid industrialisation and urbanisation on our climate and environment. Most of the major

rivers which were once the pride of Indian civilisation are now in a state of utter crisis. For decades, our lakes, rivers and water bodies have been neglected and used as dumping grounds for the waste produced as a result of our ways of living and this is despite the fact that we have developed some of the most sophisticated laws for environment protection and pollution control that can be found anywhere in the world. But unfortunately there is lapse and default in effective implementation of the same. The successive governments have found it increasingly difficult to balance economic aspirations of citizens with the need to preserve and protect our common resources.

1.6 Our Father of the Nation, Mahatma Gandhi, once said, "Earth provides enough to satisfy every man's need but not every man's greed". It is indeed the greed of the mankind which has brought about the environmental degradation and global warming. They are, in fact, destroying those natural resources which in fact sustain them. Apart from the issues of pollution and deterioration of quality, some of the biggest issues have been with respect to the modalities of usage of river waters which is the main source for getting fresh water.

1.7 Some of recent statistics have thrown light on the scale of the problems that may emerge if corrective steps are not taken. The rapid growth of population has meant that annual per capita availability of fresh water has declined sharply from 5177 cubic metres in 1951 to 1544 cubic metres in 2011. In order to match with the rapidly increasing demand, India needs to make a delicate balance of surface water and ground water which could be met through methods and means that are sustainable over the time, both from the point of view of meeting the developmental needs and preserving the eco system.

1.8 Due to India's federal structure, another area of immense concern has been with respect to sharing of water resources amongst the riparian States. Considering the vast length of most of the Indian rivers, it is inevitable that these rivers often pass and flow through two or more States. That automatically raises complex problems with respect to the usage and management of water and the rights of the States in that regard. There has been conflict in the concept of proper management and use of water resources carried through rivers not only in India but in other countries as well. Such conflicts and disputes of sharing the water of the rivers has been a major factor in almost all the countries including India.

1.9 After annexation of our country by the British and with the introduction of proper method and modern ways of governance in India, proper attention was given for resolution of such disputes amongst the States. This is probably because of the fact that the Britishers were themselves aware of the issues with regard to the rights in flowing water. Halsbury's Laws of England has explained the said rights in flowing water, like river, as follows:

> "63. *Rights in flowing water at common law.*- Although certain rights as regards flowing water are incident to the ownership of the riparian property*, the water itself,* whether flowing in a known and defined channel or percolating through the soil, *is not, at common law, the subject of property or capable of being granted to anybody. Flowing water is only of public right in the sense that it is public or common to all who have a right of access to it.*
> (Emphasis supplied)"
>
> (Halsbury's Laws of England, Vol.100 (5th Edn., Lexis Nexis 2009) 78, para 63)

1.10 In the light of the aforesaid legal position prevalent in the United Kingdom, the rules of our country made applicable the same legal position and status. Our Constitution broadly adopts this scheme of the Government of India Act, 1935, which law was enacted by the British. Prior to the enactment of the said laws, governmental power was centralised in the Secretary of the State. Under the Government of India Act, 1919, it was provided that no major irrigation project could be undertaken without the express sanction of the Secretary of the State. In case of a dispute between Provinces (States), the matter had to be referred to the Secretary of the State whose decision was final and binding on the Provinces concerned.

1.11 Subsequent thereto, greater provincial autonomy followed in the form of Entry 19 of List II to the Seventh Schedule of the Government of India Act, 1935. By making the aforesaid Entry to the Seventh Schedule of the Government of India Act, 1935, power to legislate on "water, that is to say water supplies, irrigation and canal, drainage and embankments, water storage and water power" was transferred to the Provincial Government. The executive authority of the Provinces was also made co-terminus with their legislative powers in terms of Section 49(2) of the Act of 1935, leaving the Provincial Government free to do what they thought fit in respect of water supplies within their Provinces. The aforesaid position was, however, subject to the provisions of Sections 130 to 133 under which the Governor General could, on the basis of a complaint by one Province against another regarding interference with its water supplies, appoint a Commission to investigate the matter. After completion of the

investigation, the Commission was expected to submit a report based on which the Governor General could pass final orders, unless any party to the dispute desired a reference to His Majesty-in-Council for final order. Such orders made by the Governor General or His Majesty-in-Council were binding on the Provinces affected, unless varied by the Governor General or His Majesty-in-Council on the basis of an application filed to that effect.

1.12 These provisions enacted in the Government of India Acts of 1919 and 1935 clearly provided safeguards to the effect that no Province could take any action that would prejudicially affect the interest of another Province or its people. The aforesaid provisions in the two Government of India Acts were almost retained in the structure of the Indian Constitution which ensures that no State or the residents of the States within the Union has any proprietary or ownership rights over inter-State or international river waters running through its boundaries. Such river waters running through two or more States can be brought under the control and guardianship of the Union of India by a legislation enacted under Entry 56, List I of the Seventh Schedule to the Constitution as it was considered that the waters of such rivers are meant for national social purpose such as the welfare of all the people of India. The Supreme Court of India in the case of *State of Karnataka vs. State of Andhra Pradesh*, reported in 2000 (9) SCC 572, laid down that water under all prevalent systems of law has been declared to be the property of the public and dedicated to their use, subject to appropriation and limitation as may be prescribed either under law or by settlement or by adjudication.

1.13 By exercising the aforesaid power provided under Entry 56 of List I of the Seventh Schedule, the Government of India enacted a legislation prescribing regulation and development of inter-State rivers and river valleys with the aim of providing public interest. Entry 56 of List I of the Seventh Schedule to the Constitution and Article 262 providing for the manner of adjudication of dispute relating to use, control and distribution of the water provide thus:

> "**Entry 56**. Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."
>
> "**Article 262.** *Adjudication of disputes relating to waters of inter-State rivers or river valleys.* – (1) Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.
>
> (2) Notwithstanding anything in this Constitution, Parliament may by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1)."

There could be no dispute to the fact that the Inter-State River Water Disputes Act, 1956 is a legislation within the meaning of the aforesaid Article.

1.14 Although the Constitution was adopted in the year 1950 yet, no such legislation was brought about till the year 1956 when the aforesaid Inter-State Water Disputes Act, 1956 was enacted for the first time to provide for adjudication of disputes relating to waters of inter-

State rivers and river valleys which was extended to the whole of India. In the said Act, now called Inter-State River Water Disputes Act, 1956 (as amended upto 2002), a definition clause is provided where the expression "water dispute" was defined to mean as follows:

> *"**2(c)** "Water dispute" means any dispute or difference between two or more State Governments with respect to –*
>
> *(i) the use, distribution or control of the waters of, or in, any inter-State river or river valley; or*
>
> *(ii) the interpretation of the terms of any Agreement relating to the use, distribution or control of such waters or the implementation of such Agreement; or*
>
> *(iii) the levy of any water rate in contravention of the prohibition contained in section 7."*

1.15 Section 3 of the Act provides for filing of a complaint to the Central Government by any State Government when it appears to the said State Government that a water dispute with the government of another State has arisen or is likely to arise. When such a complaint is received as provided for under Section 3 of the Act by the Central Government from any State Government in respect of any water dispute and when it appears to the Central Government that the water dispute cannot be settled by negotiation, the Central Government under Section 4 of the Act was entrusted with the power of constituting a Water Dispute Tribunal for the adjudication of such a water dispute. After constitution of the Water Disputes Tribunal, the Central Government has to make a reference, under Section 5(1) of the Act, of the water dispute and any matter appearing to be connected with or

relevant to the said dispute to the Tribunal for adjudication. When such a reference is made after constitution of the Tribunal for adjudication, the Tribunal is obliged under Section 5(2) of the Act to investigate the matter referred to it and forward to the Central Government a report setting out the facts as found by it and giving its decision on the matters referred to it. It is also provided that the Central Government would publish the decision of the Tribunal in the official gazette and the said decision shall be final and binding on the parties to the dispute and shall be given effect to by them. It is provided in Section 6 of the Act that as and when the decision of the Tribunal is published in the Official Gazette by the Central Government, the same shall have the same force as an order or decree of the Supreme Court.

1.16 The Central Government has also been given the power under the said Statute to frame a scheme or schemes so as to give effect to the decision of the Tribunal. These are the basic provisions for adjudicating a conflict and dispute that arises between two or more States in connection with regulation and development of inter-State rivers and river valleys. Under Section 11 of the Act, a bar of jurisdiction has been created for the Supreme Court and other Courts providing that these Courts would not exercise jurisdiction in respect of any water dispute which could be the subject matter of a Tribunal.

1.17 Like the bees collecting nectar (honey) from the flowers and putting it collectively in a beehive for proper use, similarly Mr. K.K. Lahiri in his book “Inter-State River Water Disputes Act, Genesis, Evolution and Analysis” has summarised the laws prevalent in India concerning the rights of the States in the running and flowing waters of

inter-State rivers collecting it from various Reports submitted by different Water Disputes Tribunals like Ravi and Beas Waters Tribunal, Narmada Water Disputes Tribunal and Report of the Indus Commission as follows:

"*The law in India – a summary*

1.4.46 Thus, the law in India as to the rights of States in the running or flowing waters of inter-State rivers is as follows:

1. No State has a proprietary right in a particular volume of water of an inter-State river either on the basis of its contribution to the available flow, or drainage area, or at all. It is well established that the waters of a natural stream or other natural bodies are not susceptible to absolute ownership as specific intangible property.

[*Report of the Narmada Water Disptues Tribunal, Vol.I, p.114, para.8.8.1*]

2. The Ravi and Beas Waters Tribunal takes the proposition further, holding that the rights of the States are not dependent on political boundaries, since Articles 2 and 3 empower Parliament to form new States by separating territories or by uniting two or more States. Thus, given the paramountcy of the Union's power, the rights of States cannot be determined by reference to only political boundaries.

[Report of the Ravi and Beas Waters Tribunal, p.99]

3. A State Government can take legislative or executive action under Entry 17, List II of the Seventh Schedule to the Constitution of India as long as it does not prejudicially affect the rights of other States in the waters of the same inter-State river.

[Report of the Narmada Water Disputes Tribunal, Vol.I, p.108, para. 8.2.9]

4. The law governing the rights of States in respect of waters of inter-State rivers under the Indian Constitution is almost identical to the law under the provisions of the Government of India Act, 1935.

[Report of the Narmada Water Disputes Tribunal, Vol.I, p.108, para. 8.2.9]

5. Even under the Government of India Act, 1935, no Province had an entirely free hand in respect of a common source of water such as an inter-Provincial river and no Province could claim to do whatever it liked with the waters of a river, regardless of the injury it might inflict on other Provinces lower down.

[Report of the Indus Commission, Vol.I, p.21, para.26 and p.23, para.29]

6. Article 262 recognises the principle that no State can be permitted to use the waters of an inter-State river so as to cause prejudice to the interests of another riparian State, or of a State in the river valley, or the inhabitants thereof.

[Report of the Narmada Water Disputes Tribunal, Vol.I, p.108, para. 8.2.9]

7. Power to legislate ought not to be confused with ownership of proprietary rights and no State has any proprietary rights in river waters.

[Report of the Ravi and Beas Waters Tribunal, pp.93-94]

8. Indian and American laws differ on the distinction between legislative power and ownership rights. Unlike Indian States, American States were independent sovereign units, which together decided to form a federation. Therefore, the *inter se* rights of States in river waters in the federation known as the United States of America would be a little different from that of India; consequently, American decisions should not be blindly followed.

[Report of the Ravi and Beas Waters Tribunal, pp.99 and 106]

9. The best test to define the limits of permissible executive or legislative action of a State is where there is a prior agreement.

[Report of the Indus Commission, Vo..I, p.23, paras.30, 31. Also see, Report of the Narmada Water Disputes Tribunal, Vo.I, p.108, para 8.3.1]

10. Where there is no such agreement, however, the rights and legitimate interests should be ascertained by the principles of equitable apportionment.

[Report of the Indus Commission, Vo..I, p.33, para.51. Also see, Report of the Narmada Water Disputes Tribunal, Vo.I, p.108, para 8.3.1]

11. However, the rule of equitable apportionment should be modified in its application in India.

[Report of the Indus Commission, Vol.I, p.50, para.67]"

1.18 Having provided the background facts and origin, evolution and upon making an analytical study of the legal position as prevalent in United Kingdom and India with its historical background, it would be now necessary to enter into and discuss the issues and problems that arise for our consideration out of the Reference made to us.

1.19 The matter in hand before this Tribunal, constituted by Ministry of Water Resources, Government of India Notification No.S.O.465(E) dated 24th February, 2010, issued under Section 4 of the Inter-State River Water Disputes Act, 1956 (effective date of constitution of the Tribunal being modified to 17th September, 2012 vide Notification No.S.O.778(E) dated 14th March, 2014) relates to Water Dispute regarding the Inter-State River Vansadhara and the river valley thereof.

1.20 Exercising the powers as provided under Section 5(1) of the Inter-State River Water Disputes Act, 1956, a Reference has been made by the Central Government to this Tribunal vide letter dated 19th March, 2010 for adjudicating and deciding the dispute arising between two States, namely, State of Odisha and State of Andhra Pradesh with regard to the use and management of the water by the said two States in respect of the Vansadhara river and the river valley thereof. The Vansadhara river originates in the State of Odisha and after flowing in between the two aforesaid States enters sea in the Bay of Bengal. The Vansadhara river has some uniqueness and peculiarity with which we must be acquainted with and, therefore, they are being discussed in the next chapter.

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2

VANSADHARA RIVER BASIN

2.1 We are concerned with the dispute arising out of use, distribution, regulation and management of water of a river called "Vansadhara." This river is a southern-east flowing river between Mahanadi and Godavari in Southern Odisha and North-East Andhra Pradesh States in India.

2.1.1 The river originates near the village Lanjigarh in the border of Thuamul Rampur in the Kalahandi district and Kalyansinghpur in Rayagada district of Odisha at an elevation of 1300 metres above sea level. The name "Vansadhara" probably originates as the origin of the river is from a forest area with bamboo grooves. Etymology of the word "Vansa" comes from Vansh meaning Bamboo and "dhara" meaning water flow. Consequently, the river was named "Bansadhara" in Odiya and as "Vamsadhara" in Telugu. The river flows for a total length of about 265 km from its origin till it gets merged into the Bay of Bengal, out of which 154 km of its length lies within the State of Odisha, 29 km forms the common boundary between Odisha and Andhra Pradesh, and the remaining 82 km lies within the territory of Andhra Pradesh before it falls into the Bay of Bengal.

2.1.2 There is no dispute with regard to the fact that approximately 29 km length of the river forms the common boundary between Odisha and Andhra Pradesh. For the aforesaid length of the river totalling 29 km, the river runs along within the State of Odisha on the eastern side

whereas other part of the river runs along the territory of Andhra Pradesh on the western side and the inter-State boundary of the two States being practically in the middle of the river as decided by the Survey of India. The Vansadhara River has its course of flow in the south-easterly direction until it enters Andhra Pradesh where it changes its direction towards South and flows in that direction upto Madras-Howrah Railway line. Then it takes its course in South Easterly direction till it merges in the Bay of Bengal at Kalingapatnam.

2.1.3 There are several villages situated on both sides of the river bank covering the aforesaid 29 km of the river forming the common boundary. Few villages are situated on the bank of the river within the territory of Odisha and according to State of Odisha, villagers of about 18 villages are dependent on the water of Vansadhara whereas there are few other villages on the Western side of the river within the territory of Andhra Pradesh which are also stated to be dependent on the water of Vansadhara for the agricultural purposes and also for drinking purposes. A list of 18 villages in Odisha is annexed as Annexure-1 hereto for ready reference. However the correctness or otherwise of the said statement would be considered while discussing the rival contentions of the parties. Similarly, according to the State of Andhra Pradesh, the Neradi Barrage Project was proposed to be constructed with the intention of providing irrigation facility particularly to 203 villages, covering an area of 1,07,280 acres of land in Srikakulam District. This claim would also be subject to scrutiny at appropriate stage.

2.1.4 There are number of tributaries of the river Vansadhara. The prominent tributaries of river Vansadhara are Bengigedda, Pedagada on the right and Chuladhua Nalla, Pondaka Nalla, Harabhangi, Sananadi and Mahendratanya situated on left. The Schematic map of river Vansadhara is at Annexure-2. The last river named Mahendratanya is a major tributary of Vansadhara originating in Gajapati district of Odisha and then joining Vansadhara in Andhra Pradesh upstream of Gotta Barrage. Except Mahendratanya river, all other tributaries are meeting Vansadhara river upstream of proposed Neradi Barrage site.

2.1.5 A brief idea about some of these major tributaries is given hereinafter:

The first tributary is **Chuladhua Nalla** which meets Vansadhara river on its left at a distance of 77.5 km from the origin of Vansadhara. This tributary originates near the village Madagurah and flows mainly through Rayagada District. The length of the tributary is about 58.25 km.

Thereafter, **Pondaka Nalla** joins Vansadhara river from the left at a distance of 80 km from the origin of Vansadhara. This tributary originates near the village Sunapur and flows mainly in Rayagada District. The length of the tributary is about 36.5 km.

The next tributary to meet Vansadhara river is **Harabhangi river** which joins it at a distance of 110 km from the origin of Vansadhara. It originates near the village Kerakhela and flows mainly through Gajapati District. The length of this tributary upto the confluence is about 81.50 km.

Thereafter, **Bangigedda** meets Vansadhara on the right at a distance of 123.75 km from the origin of Vansadhara. The next tributary is **Sananadi river** which is a left tributary and meets Vansadhara river at 145 km from the origin of Vansadhara. The length of this tributary is about 91.75 km.

The next tributary to meet Vansadhara river is **Pedagada** river which is a right tributary and meets it at 150 km from the origin of Vansadhara. The length of this tributary is about 48 km.

The last principal tributary of Vansadhara is **Mahendratanya** river which meets it from the left upstream of Gotta barrage in Andhra Pradesh at a distance of 205 km from the origin of Vansadhara. It originates near the village Badakua and flows mainly through Gajapati District. The length of the tributary from its origin upto the confluence is about 46.75 km.

2.1.6 Vansadhara River Basin occupies 8015 square kilometers in Odisha and the remaining 2815 square kilometers lie in Andhra Pradesh. The Basin Map is enclosed as Annexure-3. Although the river Vansadhara originates in forest area but, it is primarily a rain-fed river with the tributaries also feeding a part of its flow.

2.2 TOPOGRAPHY, GEOLOGY AND HYDROGEOLOGY

2.2.1 The catchment area of the Vansadhara is mostly hilly. The basin displays a wide spectrum of geological formations ranging from Archeans to recent geological formations with the former occupying over 50 per cent of the geographical area. The main geological formations are Dharawars, Peninsular granites, puranas, gondwanas

and archeans. The soils generated from the formations are mostly permeable. Since the surface is mostly covered with kankar and murum, run-off is moderate in the basin.

2.2.2 Hydro-geological studies have been carried out by the Central Ground Water Board and the State Ground Water Department of the State Government of Odisha in the basin. The studies indicate that the ground water is available in the basin under unconfined conditions in the joints, fissures and fractures extending to deeper levels beneath the weathered zone and it is suitable for developing dug and bore wells. The ground water occurs in both confined and unconfined conditions in the gondwanas where the yields are comparatively high.

2.3 CLIMATE

2.3.1 The climate of the entire basin is of tropical monsoon type, with major part of rainfall occurring during the period from June to November.

2.3.2 The rainfall characteristic and temperature of basin differ from one place to another due to its topographical position. The maximum and minimum mean temperature of the basin varies from 33^0 C to 7^0 C respectively. The basin gets most of its rainfall during monsoon. Cyclonic storms are not uncommon to the basin. The relative humidity in the basin varies from 88% to 93% during July to September.

2.3.3 As there is no meteorological station inside the basin lying in Orissa, Gopalpur IMD station has been considered for recording

climatological and meteorological parameters. There is also another meteorological station at Kalingapatnam in Andhra Pradesh.

2.4 RAINFALL

Rainfall in the basin is mainly due to southwest monsoon, which is active from June to November. About 80% of annual precipitation occurs during monsoon period. The observed annual rainfall varies from 2591 mm at Bisam Cuttack (1978) to 410 mm at Gumma (1975). Average annual rainfall in the basin is about 1400 mm.

2.5 HYDROLOGICAL OBSERVATION

There are seven hydrological observation stations under operation in Vansadhara river basin, namely, (1) Gotta Barrage, (2) Gudari, (3) Gunupur, (4) Kashinagar, (5) Kutragada, (6) Mahendragarh and (7) Mohana. Out of these, Kashinagar observation station collects the data regarding gauge, discharge, sedimentation and water quality. Gunupur station measures gauge and discharge while the rest five observation stations are collecting gauge data only. The maximum and minimum discharge observed for Gunupur station are 5286 cumecs (1991) and 0.00 cumec (2003) (observation period 1990-91 to 2015-16). The maximum and minimum discharge observed for Kashinagar station are 7322 cumecs (2007) and 0.00 cumec (2003) during observation period 1971-72 to 2015-16. There is only one silt observation station at Kashinagar. The maximum and minimum annual silt load observed at Kashinagar station are 124.73 lakh MT (1977-78) and 4.31 lakh MT (2015-16) respectively.

2.6 SITE INSPECTIONS FOR APPRECIATION OF LOCAL CONDITIONS

2.6.1 The Tribunal, in order to understand the local conditions of Vansadhara river and its river valley and also to have a first hand information about all other factors like physical, topographical and ecological condition at different locations of the river starting from Kashinagar to the site where Neradi Barrage is proposed to be constructed, made local inspections twice by the entire Tribunal consisting of the Chairman, Members and the Assessors along with the counsel, officials and representatives of both the States and once by the two Assessors only with the assistance of the representatives and officials of both the States. After completing such local inspections, reports of such inspection were prepared by the Tribunal, copies of which were given to both the States and the said reports are now part of the record.

2.6.2 The first local inspection was made by the Tribunal from 22nd to 26th April, 2013, pursuant to the order passed on 14.03.2013, to the sites where the proposed Neradi Barrage and side weir at Katragada were proposed to be constructed so as to have a first hand idea of their location and feasibility and also in respect of physical conditions of the right bank and left bank of the river. During the said visit, power point presentation was made by the Government of Andhra Pradesh before the Tribunal in which the genesis and evolution of the dispute, various issues involved and apprehensions of the State Government of Odisha were highlighted.

2.6.3 The Tribunal visited the proposed Neradi Barage site and also the proposed site of Side Channel Weir at Katragada from the right bank of the river lying in Andhra Pradesh and thereafter the sites from the opposite bank lying in Odisha territory were also visited.

2.6.4 During the said visit, it was observed that substantial amount of water was flowing in the river on 23.4.2013. The Tribunal was informed that this is due to the sudden and untimely rainfall in Andhra Pradesh during the preceding two to three days. On being asked, the Andhra Pradesh State officials stated that quantum of water would be of the order of approximately 1000 cusecs. As per the two State Governments, river forms the boundary line between the two States in the vicinity of the proposed project sites. It was pointed out by the officials of the Andhra Pradesh that there was a narrow strip of irrigated land on the left bank in Odisha territory and the area was dotted with hillocks and there was also a railway line passing parallel to the river. During the said visit, some flood protection works were also observed along the left bank of the river in Odisha territory.

2.6.5 The Tribunal then visited the proposed site of side weir at Katragada. During the said visit it was pointed out by the officials of the Odisha Government that the location of the side weir is on curve of the right bank and also that there is a natural high ground in the middle of the river bed which will bifurcate the river flow. They also contended that after the construction of the side weir these physical characteristics would cause morphological changes in the river which will adversely affect the interests of Odisha. The officials of Andhra Pradesh, however, pointed out that the side weir was a temporary arrangement

to draw only 8 TMC of water to meet the partial needs of the State. They also told the Tribunal that the side weir would be submerged once the Barrage at Neradi was completed. Odisha officials were of the view that the sill level of the side weir could be raised further and the length of the side weir which is 300 metres could be reduced to about 165 metres, as it would be sufficient to serve the intended purpose. Andhra Pradesh officials also stated that it was possible to get sufficient discharge over the side weir only during 55 days in a year with the dimensions already fixed.

2.6.6 The Tribunal then visited the Hiramandalam Reservoir site. The water from Neradi Barrage is proposed to be brought to this Reservoir through a high level canal passing through Singidi and Parapuram Balancing Reservoirs. The Tribunal was then also taken to Gotta Barrage which was completed in the year 1978. Odisha representatives pointed out to the silt accumulated upstream of this Barrage and stated that similar situation would arise upstream of Neradi Barrage also when constructed to which the Andhra Pradesh officials countered by saying that this is a natural phenomenon and can be taken care of through flushing and other desilting measures.

2.6.7 On 24.04.2013, the Tribunal along with the concerned officers first visited the left bank of the river which is mainly situated within the territory of the State of Odisha. While doing so, the Tribunal also visited the Gauge and Discharge (G&D) site of CWC at Kashinagar. The CWC officers managing the site explained about the nature of the data being collected at that site. From the data provided by the CWC officers, it was observed that the water discharges in the river on 19th,

20th, 22nd and 23rd April, 2013 were 90.52, 271.52, 940.97 and 663.92 cusecs respectively. The Tribunal then visited Sara Village which is near the left abutment of the proposed Neradi Barrage. After that, the Tribunal visited the river bank near Badigam village which is opposite to the Katragada Side Weir on the other bank. From this local inspection made, the Tribunal could collect the information and have a first hand knowledge about the situation of the flow in the river Vansadhara and also could acquaint itself with the site conditions at Neradi Barrage and Katragada. The Tribunal also visited Central Water Power Research Station (CWPRS), Pune to inspect the physical models of Neradi Barrage and Side Weir on 3.5.2013. The inspection report forms part of the record and is placed as Appendix-1 in Volume-III (APPENDIXES).

2.6.8 The Tribunal made a second visit of Odisha and Andhra Pradesh from 18th March, 2014 to 25th March, 2014 during the course of which the Tribunal visited the site of the proposed Neradi Barrage on 21st March, 2014 from right bank lying in the State of Andhra Pradesh. The discharge of river as observed by the CWC at Kashinagar on that date was 339 cusecs. Some flood protection works could also be observed along the left bank of the river which falls within the area of Odisha territory. The Tribunal was also informed that the total length of the proposed barrage at Neradi was about 700 metres.

2.6.9 Large scale maps of the river basin and various components of the proposed project were displayed by the Andhra Pradesh Government. The maps included natural flood plan, flood plan with barrage, area of submergence with barrage, layout of the barrage and the section of protection work on the left bank. The salient features of

the proposed barrage were also displayed. The State of Andhra Pradesh had arranged for the inspection of the longitudinal section and other topographic features of the river upstream of the proposed barrage. The Tribunal travelled in the bed of the river 3 km upstream of the proposed barrage. The Tribunal was informed that Bathili village is the first village in Andhra Pradesh from where the common boundary between the two States starts. At this location, the river width has increased to 1.6 km thereby reducing the scope of flooding on account of the increase in the carrying capacity of the river. The Tribunal desired to know and to be supplied with the detailed computation of submergence area due to backwaters so that the extent of flooding in both the States could be appreciated. The Tribunal inspected the elevated ground in the bed of the river nearly 3 km upstream of the proposed barrage. At this location the river was flowing towards the left bank. Thus it was noticed that there was a change in the flow pattern of the river. At some locations it is flowing towards the left bank (Odisha) and at some places towards the right bank (Andhra Pradesh). During the inspection it was explained by the officials of the State of Andhra Pradesh that during the 1980 unprecedented flood, even the elevated mound was completely submerged**.** The report is placed as Appendix-2 in Volume-III (APPENDIXES). The Tribunal visited CWPRS, Pune from 3rd to 5th December, 2014 along with the counsel and officials of the two States. The Report of this visit is placed as Appendix-3 in Volume-III (APPENDIXES).

2.6.10 Subsequent thereto, the two Assessors of the Vansadhara Water Disputes Tribunal had to make another visit to the proposed site

of Neradi Barrage and side weir at Katragada and some other sites due to compelling circumstances of new Assessor namely, Shri M.S. Agrawal joining as an Assessor in the Tribunal in place of Shri S.K. Sinha who retired from the Tribunal. The two Assessors, being so permitted by the Tribunal, visited the concerned sites from 24th to 26thApril, 2017 and submitted a report with regard to the physical features and topography, amongst other features. During the course of their local study they visited the Right Bank of the river particularly the site of the proposed Neradi Barrage and proposed side weir at Katragada (from the Right Bank i.e. Andhra Pradesh) and Flood Flow Canal and its ancillary structures, Singidi and Parapuram Balancing Reservoirs, Hiramandalam Reservoir, Gotta Barrage and Bhyri Open Head Channel Mouth along with officials of the Governments of Andhra Pradesh and Odisha.

2.6.11 Regarding the proposed Neradi Barrage, the report recorded that they were informed that the length of the barrage between the abutments would be 696 metres with 30 numbers of spillway vents. The sill level of the spillway vents would be 67.970 metres and pond-level would be at 71.630 metres. The site of the proposed barrage was visited from the right bank of the river i.e. Andhra Pradesh side. It was observed that the flow in the river was quite less, say of the order of less than 100 cusecs.

2.6.12 The officers of Odisha mentioned that there would be submergence upto 9 km. upstream from the barrage while considering the design flood of 6 lakh cusecs and heavy siltation on upstream side of the barrage, which would affect interests of Odisha.

2.6.13 Thereafter they visited the site where construction of the side weir at Katragada is proposed. At the site the Assessors were shown

the layout plan of side weir, flood flow canal and its head regulator, escape channel and silt ejector along with other design features related to the side weir. They were informed that the sill level of the side weir has been fixed in such a way that the flow exceeding 4000 cusecs in the river would spill over the side weir towards the flood flow canal and in case the flow is less than 4000 cusecs all the water will flow into the river. Besides, the flow spilled over the side weir exceeding 8000 cusecs, would come back to the river through the Escape Channel.

2.6.14 It is recorded in their report that subsequent to passing of the order dated 17.12.2013 by the Tribunal, construction of side weir at Katragada, Flood Flow Canal and its Head Regulator etc. were in progress. 40% work of the side weir was reported to have been completed and that 25% work of Head Regulator and 25% work of Scour Sluice was also being completed. It is also recorded that works relating to stilling basin and Escape Channel etc. were also in progress. During the said visit, officials of the Odisha reiterated their apprehension that the side weir was located at the bend in the river where the flow in the river approaches the side weir almost at perpendicular direction and maximum water would be withdrawn by Andhra Pradesh through the side weir. They also mentioned that there will be aggradation on the left bank on Odisha side of the river.

2.6.15 Thereafter, the two Assessors visited the left bank of the river which is within the territory of Odisha and visited the Gauging site at Kashinagar and the site of the proposed Neradi Barrage from the opposite direction i.e. from the left bank of the river which is on Odisha side. They visited the left bank opposite to side weir at Katragada. When they visited the Gauging site at Kashinagar, maintained by Central Water Commission, they were informed by the staff of the

Central Water Commission that the Highest Flood Level (HFL) in the river recorded at Kashinagar was 57.64 m on 18th September, 1980 and that the discharge measured on the date of the visit was 1.02 cumecs (i.e. 36.02 cusecs) at the water level of 53.37 m. The team also visited the proposed Neradi Barrage site of the river from the Odisha side. The officials of the Odisha Government showed their apprehension that the people of Sara Village are farming on the left bank of the river and that there is possibility that their land would get submerged due to construction of the barrage which would affect the Sara village. As against the said apprehension, the Andhra Pradesh officials stated that the proposed protection wall on the left bank upstream of Neradi Barrage would provide adequate protection to Sara village.

2.6.16 The team also visited the left bank area opposite to the proposed side weir at Katragada. The officials of the Odisha reiterated that the flow of the river is approaching the side weir almost perpendicularly which would result in maximum flow of water towards right bank and aggradation of the silt towards left bank of the river. The villagers also expressed their views before the team and mentioned about likely submergence of the agricultural land due to construction of the proposed Neradi Barrage. It is recorded in the report that the villagers desired that adequate compensation may be provided to them for the same and the Sara village should be protected from the submergence in case of the construction of the proposed Neradi Barrage. The report of this visit is placed as Appendix-4 in Volume-III (APPENDIXES).

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3

DISPUTE – HISTORICAL BACKGROUND

3.1 Andhra Pradesh and Odisha are riparian States of Vansadhara River Basin. Odisha is the upper riparian State while Andhra Pradesh is the lower riparian State. It is needless to state that the people inhabitating the villages located near the river are totally dependent on the water of the river for the purpose of drinking, agriculture, for their livelihood and also for the livelihood of the live stocks. After attaining the independence, it became necessary to work for development of the river valley and take steps for the progress of the people of the entire country. Steps were, therefore, taken for development of Vansadhara river basin by providing welfare measures and facilities to the inhabitants living in the villages situated on the side of the State of Andhra Pradesh. Various projects were initiated and finalised and one of such welfare measures was to construct reservoirs and barrages so as to make available water of the river to the people who are in need of such water on the side of State of Andhra Pradesh.

3.2 The State of Andhra Pradesh somewhere in 1950 proposed construction of Gotta Reservoir and Neradi Barrage across river Vansadhara. In terms thereof, Andhra Pradesh constructed Gotta Barrage consequent upon which some area of the agricultural land on the side of Andhra Pradesh was submerged. The construction of the aforesaid Gotta barrage was completed somewhere in the year 1977.

3.3 The proposal to construct the Neradi barrage across the river Vansadhara called Neradi Barrage was proposed to be constructed

48 km upstream of Gotta Barrage. The location of the barrages could be seen in the map enclosed as Annexure-3. Since the said project when constructed would result in submergence of some land in Odisha, mutual consultations between Governments of Andhra Pradesh and Odisha were necessary and required. Both the Governments decided to resolve the matter through cooperation and with the intent of flexibilities so as to accommodate each other. Such spirit of cooperation and flexibility is demonstrated from the mutual discussions that were held between both the Governments at different points of time for about five decades.

3.4 Records of such continuous and repeated mutual discussions between the Governments of Odisha and Andhra Pradesh are filed before us which indicate that negotiation and discussion took place between both the State Governments and an agreement was arrived at on 18.7.1961 in presence of and signed by the then Chief Minister of Odisha and the then Chief Minister of Andhra Pradesh. The aforesaid agreement dated 18.7.1961 is placed on our record which indicates that an inter-State Conference was held between the Chief Ministers of Andhra Pradesh and Odisha at Hyderabad on 17th and 18th July, 1961 at which apart from the Chief Ministers, other officials of the two State Governments were present. After discussion, a resolution was adopted in respect of construction of Neradi barrage on Vansadhara river. The said resolution records that the Andhra Pradesh representative stated that they wanted to execute the irrigation project at Neradi which entails the acquisition of 106 acres of land in Odisha territory and they requested Odisha Government's concurrence to go ahead with the

project. It was also indicated in the said resolution that it might be possible to irrigate some areas of Odisha through the said Project. A no objection of the Odisha Government to the said proposal was recorded stating that while the Odisha Government has no objection to the said proposal, they wanted to safeguard against the water logging of their area and therefore the State of Odisha have asked for certain details. It was also recorded that as soon as the details are received, Odisha Government would communicate their concurrence to the Project.

3.5 Subsequent thereto, another meeting took place between the officials of both the States on 4th September, 1962 where the following resolutions were taken:

> *"1. As regards Neradi barrage, the design of the anicut and location of the top level of flood bank proposed and arrangements to be made for providing drainage of the area of the off side of the flood bank in Orissa State were examined in detail with reference to the Plans. The expected maximum flood discharge and the maximum flood level upstream and downstream of the anicut were also examined.*
>
> *2. It was agreed that the design proposed by the Andhra Pradesh Engineers for the flood bank and arrangements proposed by the Andhra Pradesh for the drainage sluice were generally acceptable.*
>
> *3. The Orissa Engineers desired that they may be given the finally approved design of the out fall sluice and this may cater for a run off of 1" per hour in the catchment under reference. The flood bank should have 6" of free board above M.W.L. with 2 feet pitching above M.W.L. in the river side.*
>
> *4. The Orissa Engineers also agreed that a sluice may be provided on the left flood bank at a place to be*

indicated by them and of the size to be indicated by them for any future irrigation to be proposed in their territory and the cost of the sluice would be borne by them. If and when, in future irrigation is decided in Orissa State the cost of the proposed anicut will be borne on ayacut basis.

5. The Neradi irrigation proposes to provide on the Andhra side for first crop only. It was agreed that the existing irrigation interests both under Orissa and Andhra Pradesh are in the Vamsadhara river basin will be a first charge on the waters. It was also agreed that the water requirements of the Neradi Project will be met out of what was agreed to under Gotta reservoir scheme previously. Orissa Engineers had no objection to the Neradi Project subject to the above conditions.

6. The Andhra Engineers stated that there is no proposal for additional irrigation beyond what is now proposed for under the Neradi barrage and Gotta Reservoir. The Andhra Pradesh Engineers therefore had no objection to the utilisation by Orissa State of the balance of waters under Vamsadhara subject to the protection of the existing irrigation interests in Andhra area which is roughly estimated at 10 T.M.C ft. The Orissa Engineers requested Andhra Engineers to send the working tables for the Neradi Barrage and Gotta Reservoir so that they may examine them and give their requirements for abstraction of water from Vamsadhara river and thereafter the two Chief Engineers will meet and provide the necessary basis for final allocation of waters in Vamsadhara basin."

3.6 The next discussion that took place between the officials of the two Sates was on 30th September, 1962. After conclusion of the aforesaid discussion it was recorded that from the data available it has been estimated that the yield of Vansadhara river at Gotta Reservoir is 115.00 TMC. The requirement of Andhra Pradesh for Gotta Irrigation

Project and Neradi Anicut is 47.4 TMC. The total quantity of water for the existing irrigation in Andhra Pradesh is about 7 TMC and so, the total requirement of water of Andhra Pradesh for the existing irrigation and projects which are now being taken up is 54.5 TMC. It was also recorded that the requirement of water for the projects of Odisha State has been roughly estimated to be 55 TMC. The resolution further provided that the yield of Vansadhara is just sufficient to meet the requirements of both the States. It was agreed by both the States that the water of Vansadhara Basin may consequently be utilised by both Andhra Pradesh and Odisha States on a fifty-fifty basis. It was further agreed that both the projects namely Gotta Irrigation Project and Neradi Project could be taken up immediately on the aforesaid basis.

3.7 So far as the Project Report for Neradi Barrage is concerned, the same was placed by Andhra Pradesh in the meeting held on 27th July, 1980 so as to settle outstanding matters in respect of Vansadhara River. It was recorded as follows:

> *"A) Andhra Pradesh will confine acquisition of Orissa lands to 106 acres as originally provided in the proceedings of the interstate agreement. It was agreed that the 106 acres acquisition would be exclusive of the river bed. It was also agreed that the left bank would be realigned and redesigned with the above acquisition in view. It was agreed that the embankment will be done with revetments wherever necessary and the money would be deposited with the Govt. of Orissa for execution of the left flood bank. The expenditure on the maintenance over flood bank, it was agreed, will be a charge on the project. The problem regarding water logging in the rear of left flood bank was discussed and it was agreed that catch drains on the land side of the embankment would be provided to avoid water-*

logging. It was agreed that the construction of flood banks on both sides of the river should be taken up simultaneously.

B) The Chief Engineer, Irrigation, Orissa State pointed out that the original agreement provided for utilisation of water only during the first crop period of Neradi Barrage. It was agreed that the project report should be revised for ensuing withdrawal of water from Neradi barrage during the first crop period and all flow thereafter or beyond first December is let down in the river for use by both the States."

3.8 Another meeting was held thereafter on 22.6.1981 between the Officers of both the States and the issue regarding the Neradi Barrage was also discussed under Item V. After detailed discussions, the contentions of both the Governments were recorded. The Andhra Pradesh Engineers expressed their opinion regarding proposed Barrage at Neradi that they were anxious to proceed with the project to which the representatives of the Odisha stated that adequate waterway should be provided in the design of the barrage, taking into account the high flood of 1980 and limiting the submersion to 106 acres. In reply to the said contention the representatives of Andhra Pradesh stated that they would redesign the barrage taking into account the impact of the flood of 1980 and also the CWC guidelines for design of the barrage and that they would send the Project Report to the Government of Odisha as soon as it is ready. Further, they stated that if 1980 flood is to be provided for, submersion in Odisha may exceed 106 acres. In respect of the same, representatives of Government of Odisha stated that they could not agree to any proposal which would be contrary to the inter-State agreement but the State Government of Odisha would, however,

be in a better position to offer their views on the subject after receiving the project report.

3.9 The inter-State agreement that is referred to is the agreement which was arrived at in the meeting dated 18.7.1961 restricting the acquisition of land on the Odisha side to an area of 106 acres which was again reiterated in the meeting dated 27.7.1980, with a further clarification that the said area of 106 acres would be exclusive of river bed.

3.10 The Central Water Commission was also involved in the discussion held between the two States on 10.1.1984. The meeting was held under the Chairmanship of the Member (WR), CWC and ex-officio Addl. Secretary to the Government of India and Officers of the Government of Andhra Pradesh and Odisha and also Officers of the Central Water Commission were present wherein the heavy flood that had taken place in the Vansadhara river in September, 1980 was also discussed in the back drop of Vansadhara Stage II Report which provided for construction of Neradi barrage across Vansadhara river about 16 km downstream of Gunupur town in Odisha. As per the revised project report of 1982, the barrage and its appurtenant works like afflux bunds etc. were proposed to be designed for a maximum flood discharge of 5.0 lakh cusecs.

3.11 It was recorded therein that the State of Odisha had expressed that the 1980 heavy flood was much larger than 5.0 lakh cusecs and, therefore, that would necessitate revision of the project proposal as submitted by Andhra Pradesh as per the terms of existing Inter-State agreement of Vansadhara. Subsequent to discussion, it was agreed that inspection and surveys would be carried out by the officers

of Andhra Pradesh and Odisha after which the CWC would review the present estimates of maximum discharge considering and taking note of the impact of the 1980 floods, if possible. It was also recorded that review of the flood of Neradi barrage could thereafter be carried out, if necessary with the information collected during the review of 1980 floods and other hydrological data.

3.12 The technical issues regarding Vansadhara Project Stage-II proposed by the Government of Andhra Pradesh was again discussed in the meeting held on 9.2.1985 wherein the Member (WR), CWC with his officers were present along with the officials of Andhra Pradesh and Odisha. In paragraph 2 of the resolution taken, it was agreed by all three parties that the barrage should be designed for a peak flood of six lakh cusecs at the Neradi site.

3.13 Another resolution which was adopted in the said meeting was Resolution No. 9 which reads as follows:

> *"The next major point was regarding the submergence. As per present proposal, it was indicated that at pond level the submergence was 98 acres excluding river bed. However, additional land would be required for the afflux bunds and catch drains and the actual extent of acquisition will depend on the alignment of flood banks and borrow areas and back water profile and will be calculated after computations are ready as given para 3, 4, 5 and 6. It needs also to be mentioned that certain amount of temporary submergence under flood conditions is likely to result, but it is expected that this will last for 10 to 12 hrs. only during the floods. All issues regarding submergence have to be discussed and settled at higher level."*

3.14 The records placed with us also include a copy of the minutes of the inter-State meeting held on 8.4.1988. Paragraph 1.3 thereto recorded as follows:

> *"1.3. With a view to limit the extent of land required for acquisition in Orissa territory to within 106 acres, the Government of Andhra Pradesh have formulated a proposal to construct a flood protection wall 3.5 kms. long upstream of the Neradi barrage in Orissa territory. A catch drain is also proposed for draining the water behind the protection wall. This proposal was forwarded by the Government of Andhra Pradesh both to CWC and the Government of Orissa in Feb. '87."*

3.15 The aforesaid proposal was discussed in the same meeting and conclusion that was arrived upon is also recorded in paragraph 2.2 thereof which is recorded as follows:

> *"2.2. The Afflux due to Neradi Barrage as computed by Andhra Pradesh was considered and it was agreed that the effect of this afflux beyond 3 kms. of protection wall upstream of the Barrage was within permissible limit."*

3.16 The design of protection wall is considered in paragraph 2.3 of the minutes. It was recorded that the proposed protection wall after thorough examination was found to be technically sound and feasible and that the stability of the wall in sliding was also found to be in order. Certain other details were discussed and recorded by way of separate resolutions.

3.17 Negotiations and discussions took place even thereafter between both the States as it appears from the summary record of discussions of the inter-State meeting on Vansadhara Stage II Project held on 8.3.1991 under the Chairmanship of Secretary (WR),

Government of India. In the said meeting the Secretary, Irrigation, Government of Andhra Pradesh indicated that the problem of flooding of upstream of proposed Neradi Barrage had earlier been discussed and proposal of construction of Masonry wall was finalised in consultation with the Chief Engineer, Government of Odisha. The Secretary, Irrigation offered to extend the embankment upto 10.5 km in the upstream as earlier envisaged if the Government of Odisha so desires but it may then unavoidably involve acquisition of more area. Various other discussions regarding the Neradi Barrage also took place and decisions taken after such discussions were recorded.

3.18 In an inter-State official level meeting held under the Chairmanship of Member (P&P) C.W.C., held on 22.11.1991, the representative of the Orissa Government indicated that as per inter-State agreement, the acquisition of land for works in Orissa territory should be restricted to 42.92 ha (106 acres). Keeping this in view, the proposal for the construction of masonry wall 3.8 km long was acceptable to the Government of Orissa.

3.19 Next important meeting which took place between the two States was held on 10th June, 1992 and was attended by the two Chief Ministers of the two States apart from the officials of the two States. It is clear from the minutes recorded that the States desired to settle the issue in a spirit of amity. So far as Neradi barrage was concerned, following decision was taken as recorded in paragraph 1 under the heading **"Neradi Barrage"**.

> *"Hydrology data upto 1991 and Mathematical Model Studies will be supplied by the Irrigation*

Department Andhra Pradesh within 10 days. Mathematical Model has a linkage with the aggradation of the river bed which in turn will affect the Orissa Portion by floods beyond the stipulated 3 kms. Andhra Pradesh Engineers however, assured that the backwater effect will be limited to 3 kms. Sharing of water would be on 50 : 50 basis. It was agreed in principle that Orissa Government would have no objection to the Government of Andhra Pradesh going ahead with construction of the Barrage but the height of the barrage would be subject to mathematical model studies and hydrological data."

3.20 In order to give effect to the aforesaid inter-state Government decision on Neradi barrage, further discussion took place on 30.12.1994 between the Chief Ministers of both the States assisted by their officials wherein under the heading "Neradi barrage", the following agreement and decisions were recorded:

"(1) Hydrology data available in the C.W.C. Water year Book up to 1992 was studied by the Orissa Engineers. Based on this analysis it is found that in Vamsadhara basin approximately 76.47 TMC water is available in monsoon. During non-monsoon months the yield may approximately be 7 TMC. All the available water will be shared between the two States on 50 : 50 basis annually. The above figure regarding water availability would be updated from time to time on the basis of additional data as and when available.

(2) No area in Orissa will be submerged as a result of construction of the proposed Neradi Barrage except 106 acres of land to be acquired in Orissa State for various purposes as indicated in the Project Report.

(3) To ensure that the back water stretch is limited only to 3 kms. on the upstream, the river has to be widened by removing constriction between the

chainage 10.37 to 13.65 kms. to the section as suggested in the supplementary mathematical model run by the C.W.C. The Government of Orissa, in consultation with C.W.C. will however conduct sensitivity studies within a period of 3 (three) months incorporating varying 'n' values which has not been carried out so far by the C.W.C. This study will indicate the water surface profile upstream and downstream of the barrage and the extent of likely back water stretch in Orissa. Based on the sensitivity study the height and length of the wall may need revision, the design of which will need to be agreed by the Orissa Government."

3.21 Similar discussions took place even subsequent thereto to resolve the issues and concern of both the States. However, no final decision could be arrived at leading to a continued discussion between the representatives of both the States in presence of the CWC team. It appears that in a meeting held on 7.4.2005 between CWC team and Andhra Pradesh officials, the proposal of the Andhra Pradesh for construction of side weir on the Right Bank as an alternative to Neradi barrage to draw benefits of flood flows into the Hiramandalam Reservoir through Flood Flow Canal was discussed and a Project Report thereto was called upon to be submitted by the State of Andhra Pradesh. It was also recorded therein that the ultimate intention of the Government of Andhra Pradesh is only construction of Neradi barrage with the consent of Odisha Government and construction of side channel weir is a stop gap arrangement to draw flood flows from the river into the proposed Hiramandalam Reservoir and that this proposal would be an integral part and finally fit into Stage-II of Vansadhara Project after construction of Neradi barrage.

3.22 The Physical Model Studies which were undertaken regarding the construction of Neradi Barrage were also discussed. In that regard it was recorded that the Physical Model Studies report revealed that the back water effect of the barrage will nullify at 6.00 km on upstream of Neradi Barrage which is fairly tallying with the Mathematical Model Studies done by Central Water Commission.

3.23 In the meeting held on 7.4.2005, the representative of the State of Andhra Pradesh clarified as follows:

> *"(1). The crest level of the side weir on right side of the river is fixed at +70.40 m, which will draw the flows over and above the river discharge of 4000 c/s. This arrangement will not affect the lean flows in the river and leaving the required flows down stream. Physical model tests would be conducted to finalise the design parameters considering downstream requirements.*
>
> *(2). Construction of Neradi Barrage will be taken up limiting the acquisition of land to 106 acre in Orissa territory with the proposal of protection wall and catch drains on left side of the river on the upstream of barrage for a length of 3.80 km. which will protect the villages Sara and Badigam pertaining to Orissa from submergence. The masonry/concrete protection wall has been preferred over earthen embankment to limit this land acquisition to 106 acre only."*

3.24 It was also decided and so recorded that Model Study would be conducted for the side weir also and results would be put up before the Central Water Commission.

3.25 But despite that position and action, mutual discussions and negotiations were continued in view of the fact that no final agreement

regarding the manner and the modalities of construction of Neradi Barrage could be arrived at.

3.26 On 14.02.2006, the State of Odisha filed a complaint under Section 3 of the Inter-State River Water Disputes Act before the Central Government praying for and seeking for constitution of such an Inter-State Water Disputes Tribunal. Despite submission of the aforesaid complaint, it appears that negotiations and discussions between the two States with the supervision of the Central Water Commission continued to find a solution.

3.27 Discussions for the construction of the side weir as an alternative stop gap arrangement also continued by convening officials' meetings. One of such meetings was held on 24.4.2006 wherein the Secretary of the Ministry of Water Resources, Government of India, was present along with the officers of the Central Government and both the State Governments. The proposal of Andhra Pradesh regarding construction of the flood flow canal at Katragada was discussed in that meeting. The representative of Odisha mentioned that State of Andhra Pradesh has already taken up construction of flood flow canal at Katragada to divert the water of Vansadhara without the approval of CWC and without concurrence of Odisha and, therefore, the work should be stopped by the State Government of Andhra Pradesh. They also requested for constitution of Inter-State Water Disputes Tribunal to resolve the issues. In the said meeting, following decisions were taken:

> *"(i) CWC will reassess the yield of the Vamsadhara basin by utilizing the yield series upto 2005 for which*

necessary utilization data shall be furnished by the concerned State Government expeditiously.

(ii) Both the States agree that the yield of the river is to be shared between the Orissa and Andhra Pradesh on 50 : 50 basis as already agreed and reconfirmed by the States today.

(iii) The aspect of shifting of river course due to construction of side weir at Katragada shall be studied by CWC by using the mathematical model method or by CWPRS using the physical model.

(iv) The physical model study report of Neradi Barrage conducted by CWPRS shall be made available to the CWC by State of Andhra Pradesh.

(v)Technical Committee as agreed to by the States in the meeting held on 24.2.2005 shall start holding its meetings soon. Two meetings will be held during May, 2006 itself and the outcome will be reported to the Ministry of Water Resources.

(vi) The DPR of flood flow canal shall be made available to Government of Orissa by the State of Andhra Pradesh as early as possible.

Concluding, the Secretary (WR) had suggested to the State of Andhra Pradesh to consider not to undertake construction of any canal to link Singidi reservoir to the main river stem. Both the States agreed to discuss amongst themselves the matter of stopping the works being carried out to utilize the water of Vamsadhara river in Andhra Pradesh and Orissa in the forthcoming meeting."

3.28 On 6th September, 2006, the State of Odisha approached the Supreme Court with a petition under Article 32 of the Constitution praying for constitution of a Water Disputes Tribunal for deciding the dispute arising out of proposed construction of a side weir at Katragada.

3.29 Despite several subsequent meetings between the officials of the two States and CWC, diverse and different positions were taken by the State Governments regarding construction of the Neradi barrage and also with regard to proposed construction of side weir as an alternative stop gap arrangement. No final decision and agreement could be arrived at in respect of Katragada side weir. An inter-State meeting was held on 22.1.2008 and minutes of the same were recorded which also includes the decision taken in the said meeting regarding construction of side weir at Katragada. It was recorded that so far as Katragada Side Weir option is concerned, Andhra Pradesh officials may take appropriate action with regard to the additional studies in respect of Katragada Weir suggested by Odisha. Similarly, for the option of Neradi barrage, further studies have to be conducted to establish that the submergence and backwater effect are limited to the agreed extent.

3.30 But despite several rounds of negotiations and discussions, both the State Governments failed to arrive at an agreed decision except for the decisions as recorded herein before.

3.31 A summary of the various negotiations, discussions and resolutions taken in the various meetings held between the representatives of both the States and CWC is provided and referred to so as to understand the nature of the conflict and real disputes of the parties. From the aforesaid it is crystal clear that certain agreements have been arrived at between the two States through the inter-State agreements. It is agreed position that the water of Vansadhara river would be shared and utilised by the two States on 50 : 50 basis ratio. Therefore, there is no dispute whatsoever between the two States

regarding the water sharing of this river nor has it been raised before us. Only dispute that requires adjudication by us is regarding construction of the Neradi barrage which although at one stage was mutually agreed upon but has subsequently been opposed by the State of Odisha on different facets of such construction on various grounds which becomes obvious from analytical study of the resolutions recorded in the minutes of the said meetings.

3.32 A decision was also taken in the minutes of the meeting held on 27.7.1980 that Andhra Pradesh would confine acquisition of Odisha land to 106 acres which will be exclusive of the river bed. It was also agreed that the left flood bank would be realigned and redesigned with the above acquisition in view. It was also agreed that embankment would be done with revetments wherever necessary. It was also agreed that catch drains on the land side of the embankment would be provided to avoid water logging and that the construction of flood banks on both the sides of the river should be taken up simultaneously. This is clear upon reading of the minutes of the meeting held on 27.7.1980. In the said meeting, the Chief Engineer, Irrigation of Odisha State pointed out that the original agreement provided for utilization of water only during the first crop period at Neradi barrage. Taking the said fact into consideration, it was agreed that the project report should be revised for ensuring withdrawal of water from Neradi Barrage during the first crop period and all flow thereafter or beyond first December is let down in the river for use by both the States.

3.33 It is obvious that although at one stage all the issues raised were resolved and agreement was arrived at regarding construction of

Neradi barrage and only contentious issue was with regard to the design of the barrage yet due to the unprecedented floods of September, 1980 at the site, the State of Odisha wanted Andhra Pradesh to modify the design of Neradi barrage so as to enable the people to face and combat a situation of peak flood of 6 lakh cusecs of water. The proposal of Andhra Pradesh in February, 1987 to Central Water Commission as well as to the State of Odisha proposing for construction of a flood protection wall of 3.5 km upstream of the barrage on left side of the Odisha territory and also for construction of a catch drain for draining the water behind the protection wall was also agreed upon in the meeting held on 22.11.1991.

3.34 Subsequent thereto several meetings were held between the Officers of the two States but it appears that a meeting was convened on 10th June, 1992 which was also attended not only by the Officers of both the States but also actively participated by the Chief Ministers of both the States. Regarding construction of Neradi Barrage, Andhra Pradesh assured to limit the backwater effect to 3 km and Odisha Government agreed in-principle that they would have no objection to the Government of Andhra Pradesh going ahead with the construction of the barrage subject to mathematical model studies.

3.35 Even thereafter both the Chief Ministers took part in the meeting dated 30th December, 1994 wherein the in-principle agreement of Government of Odisha to the proposal of Government of Andhra Pradesh subject to certain conditions regarding updating water availability in Vansadhara basin, restricting acquiring of land in Odisha

State to 106 acres, limiting backwater stretch to only 3 km on the upstream was recorded.

3.36 Several other meetings subsequent thereto were held with regard to feasibility and permissibility of construction of the Katragada Side Weir along with a Flood Flow Canal. The proposal of the Andhra Pradesh Government for construction of the Side Weir on its side of the river is a purely temporary and Stop Gap measure to enable State of Andhra Pradesh to draw about 8 TMC of water to meet its immediate irrigation requirements. In the said proposal the State of Andhra Pradesh has further proposed that 300 meters long side weir with the crest level of 70.4 metres (0.9 metre above bed level) is proposed at 2 km upstream of proposed Neradi Barrage. It was also proposed by the State of Andhra Pradesh that the aforesaid side weir would be so constructed that water from river Vansadhara would enter into the proposed side weir only when the discharge in the river is more than 4000 cusecs which would happen when the river would rise above the level of 70.4 metres. The aforesaid proposal of the State of Andhra Pradesh was also opposed by the State of Odisha and it conveyed its objection against the implementation of the proposal for construction of the side weir on the ground that such diversion would deprive the existing and possible irrigation projects of 30,000 acres and also would adversely affect the supply of drinking water to 18 villages, apart from causing irreparable damage to the environment, flora, fauna and river morphology. Another objection of the State of Odisha with regard to the proposal of construction of the side weir is on an apprehension that right side of the Vansadhara river would suffer degradation on one

hand whereas the left side would suffer aggradation which in turn would cause shifting of the river flow towards the right side of the bank which falls within the territory of Andhra Pradesh resulting in shifting of the river course towards the side of the Andhra Pradesh.

3.37 The aforesaid objections were considered in the meetings held thereafter between the representatives of both the States but no agreed solution thereto could be arrived at. With the contention that the State of Andhra Pradesh had started mobilising resources with the intention of going ahead with the construction of the side weir project compelled the State of Odisha to file a complaint before the Central Government in accordance with the provisions of Section 3 of the Inter-State River Water Disputes Act, 1956. The said complaint was dated 14.2.2006 as stated herein before. Therefore, it is obvious that there are agreements between the two States with regard to the construction of Neradi Barrage but the dispute is raised with regard to acquisition beyond 106 acres of land by the Government of Odisha and also with regard to possible length of the back water flow with the apprehension of the State of Odisha that it might inundate more area than contemplated earlier. The proposal of State of Andhra Pradesh for construction of a protection wall of the length of 3.5 km with drainage system behind the wall is also agreed upon but the apprehension raised by the State of Odisha is that the back water flow would go much beyond 3.5 km and, therefore, according to State of Odisha, construction of Neradi Barrage is not feasible as proposed. The proposal for construction of the side weir as a stop gap arrangement with a Flood Flow Canal is also opposed by the State of Odisha on various grounds.

Therefore, with regard to both the proposals, no fruitful result or outcome was arrived at with the allegation that the Andhra Pradesh was mobilising resources for construction of the side weir in its territory. The State of Odisha approached the Hon'ble Supreme Court with a petition under Article 32 of the Constitution of India which is being dealt with at length and in more detail in the next Chapter.

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4

INITIATION OF STATUTORY REMEDY AND CONSTITUTION OF THE TRIBUNAL

4.1 In the preceding chapter, mention is made to the various discussions that took place between the two States. We need to, at this stage, highlight some of the discussions held and resolutions adopted which would be having a bearing and direct connection with some of the areas of dispute raised in the proceeding. Our endeavour now would be to focus on the same.

4.2 Despite the fact that the State of Andhra Pradesh initiated the proposal to construct Neradi Barrage so as to enable the State of Andhra Pradesh to start irrigation process and to supply water to the cultivators of about 203 villages covering an area of 1,07,280 acres, but, in order to get the said irrigation project at Neradi executed, it required acquisition of 106 acres of land in Odisha territory. The State of Odisha agreed to the aforesaid proposal of construction of the barrage which is crystal clear from a reading of the minutes of the inter-State meeting held on 4.9.1962 and also on a reading of the letter dated 3.10.1962 of the Chief Minister of the State of Odisha informing the Chief Minister of the State of Andhra Pradesh that he had taken note of the record of the discussions held between the Engineers of the two States on 4.9.1962 and 30.9.1962 and that Andhra Pradesh might now go ahead with the construction of the Neradi Barrage.

4.3 While further negotiations and discussions were going on the design aspect of the Neradi Barrage, it so happened that during

September, 1980, unprecedented floods occurred in the Vansadhara Basin. In view of occurring of said flood of high magnitude, Odisha wanted Andhra Pradesh to modify the design of Neradi Barrage so as to be able to meet such emergency situation in future. During a meeting in February, 1985, it was agreed that Neradi Barrage should be redesigned for a peak flood of six lakh cusecs. On account of upward revision in design flood, from two lakh sixty thousand cusecs to six lakh cusecs, the temporary submergence in Odisha territory was likely to increase.

4.4 Therefore, in order to be able to confine the acquisition to only 106 acres of land in Odisha for implementing the Neradi Project, the State of Andhra Pradesh forwarded a proposal in February, 1987 to the Central Water Commission as well as to the State of Odisha duly proposing for construction of a flood protection wall of 3.5 km upstream of the barrage on left bank in Odisha territory and also a catch drain for draining the water behind the protection wall. This proposal was discussed in the meeting convened by the Central Water Commission on 8.4.1988 and the said proposal was agreed to and a decision was taken with regard to the afflux. It was agreed in the said meeting that the afflux due to the barrage as computed by the State of Andhra Pradesh and the effect of afflux beyond 3 km of protection wall upstream of the barrage is within permissible limits.

4.5 But later on, Odisha desired that mathematical model studies should be conducted before proceeding with the construction of the barrage, pursuant to which mathematical model studies were also

conducted through Central Water Commission and the Final Report was received on 27.6.2000. The result of the study shows that the protection measures contemplated by the State of Andhra Pradesh are adequate and backwater effect would be upto 6 km only. It further stated that the effect of afflux beyond 3 km of the protection wall is within permissible limit as agreed to in a meeting dated 8.4.1988. The State of Andhra Pradesh also engaged Central Water and Power Research Station (CWPRS) for conducting the physical model studies for the Neradi project. These studies were duly completed in the year 2005 and a Report was submitted to the Government of Andhra Pradesh on 28.2.2005. The finding of the CWPRS, Pune is as follows:

> *"Backwater length after the construction of Neradi barrage would be of the order of 6 km upstream of barrage for discharge equivalent to 16990 cumecs."*

4.6 Even after that, further discussions on the subject continued to take place between the representatives of the two States but despite the same, no effective result could be achieved for construction of the Neradi barrage. Alleging delay in construction of the Neradi barrage, the State of Andhra Pradesh proposed construction of a side weir and connecting flood flow canal on its side of the river at Katragada as a temporary measure to draw about 8 TMC water from the river Vansadhara to meet the urgent need to provide drinking water and irrigation facilities to the inhabitants of the command area of Vansadhara Phase-II requirement. The said proposal was for construction of a 300 m long side weir with crest level of 70.4 m (0.9 m

above bed level) at 2 km upstream of proposed Neradi barrage. It was intended that the flow from side weir, after running 2.2 km, will join at 0.3 km chainage of the planned canal emanating from right bank at Neradi barrage. From there onward, the canal is part of originally planned canal of the Vansadhara Phase-II of the Stage II Project. It was also proposed that the side weir and the 2.2 km stretch of flood flow canal at Katragada are stop gap arrangements meant to be operated until the Neradi barrage and planned canal come into operation. One of the functional strategies of the said side weir would be that when discharge in the river is more than 4000 cusecs, the river reaches this level of 70.4 m and then water would enter into the proposed side weir.

4.7 The side weir does not involve any submergence and backwater effect. The salient features of the proposed side weir are presented below:

SIDE WEIR

i.	Location	:	2 Kms upstream of proposed Neradi Barrage.
ii.	Length	:	300 m
iii.	Average Bed Level	:	69.5 m
iv.	Crest level	:	70.400 m
v.	D/S/F.S.L.	:	70.240 m
vi.	Discharge	:	181.22 Cumecs (6400 cusecs)

HEAD REGULATOR

i.	Crest level	:	69.500 m
ii.	Vents (7 no.)	:	6.7 m x 2.385 m
iii.	Excluder 5 no. vents	:	6.7 m x 2.385 m

FLOOD FLOW CANAL

(From km 0.000 to km 5.214 , i. e. up to infall regulator of Singidi Balancing reservoir)

i.	Discharge	:	226.53 Cumecs (8000 Cusecs)
ii.	Canal Section	:	36.50 m x 5.084 m
iii.	Bed fall	:	1 in 12,000
iv.	Canal bed level (0.000 km)	:	66.370 m
v.	Full supply level (0 .000 km)	:	71.454 m
vi.	Canal bed level (5.214 Km)	:	65.936 m
vii.	Full supply level (5. 214 Km)	:	71.020 m

4.8 The State of Odisha conveyed its objections against the implementation of the proposed side weir on the ground that such diversion would deprive the existing irrigation of 30,000 acres of land on the Odisha side and drinking water supply to 18 villages and would cause irreparable damage to the environment, flora, fauna and river morphology. There are several objections taken against the aforesaid proposal including the stand that in the event of such construction, the river would undergo morphological changes. It is alleged by the State of Odisha that despite such concrete objections taken by it, the State of Andhra Pradesh was going ahead with the construction of the side weir project and that also despite the decision taken in the inter-State meeting held on 24.2.2005 wherein it was agreed that no precipitated action would be taken for construction in and around the river Vansadhara. Being so aggrieved, the State of Odisha filed a complaint to the Central Government - Ministry of Water Resources, Government of India - on 14.2.2006 under Section 3 of the Inter-State River Water Disputes Act, 1956 seeking constitution of an inter-State Water Disputes Tribunal to adjudicate the water dispute in respect of the

inter-State river Vansadhara and its valley thereof with regard to the proposed construction of side weir with a flood flow canal planned on the river Vansadhara at Katragada.

4.9 The principal submission of the State of Odisha in the said complaint was that the flow canal planned by the Government of Andhra Pradesh is an ingenious method employed by it to divert entire water of Vansadhara River at Katragada towards the side of Andhra Pradesh which would undoubtedly deprive the State of Odisha and its inhabitants the water of Vansadhara. It was alleged in the complaint to the following effect:

> "The Scheme involves cutting of deep canal on the right bank of river Vansadhara at Katragada which falls in the territory of Andhra Pradesh. The left bank of the river Vansadhara falls in the territory of Orissa. If the deep canal is cut, as planned, the entire water of the river will get diverted forcing the shifting of river in due course of time. This could be possible because the canal is planned to be cut at such a place where river takes U-turn. It acts as an escape route for the water in the bent portion of the river. This is clear from the schematic diagrams prepared and annexed to this complaint as Annexure-A Colly**.** If the diversion takes place, the people dependent on the waters of the river Vansadhara, downstream of Katragada would be badly affected. The left bank of the river Vansadhara, downstream of Katragada, lies in the territory of Orissa. Drinking water to 18 villages and existing irrigation requirement for about 30,000 acres of land would be severely affected by the diversion of water through flood flow canal planned by the State of Andhra Pradesh. Apart from this, shadow would be cast on the equitable share of the State of Orissa and its inhabitants. The Government of Orissa reserves its right to lead evidence in this regard."

4.10 In the complaint the grievances of the State of Odisha were mentioned in the following manner:

"Grievances of Orissa:

> 3. In this background, a water dispute has arisen with the Government of the State of Andhra Pradesh. The interests of the State of Orissa and its inhabitants in the waters of the Inter-State river Vansadhara and its valley have been (or likely to be) affected prejudicially by:
>
> i. the executive action of the Government of the State of Andhra Pradesh in undertaking the construction of flood flow canal, taking off from right bank of the Inter-State river Vansadhara at Katragada – located on the Inter-State border;
>
> ii. the executive action of the Government of the State of Andhra Pradesh in proposing the diversion of waters of Inter-State river Vansadhara through the above flood flow canal, which –
>
> (a) would deprive drinking water requirements in about 18 villages and irrigation requirements of 30,000 acres of land situated in the downstream portion of Left Bank of river Vansadhara falling in the territory of Orissa;
>
> (b) would result in drying up the existing river bed and consequent shifting of the affecting ground water table;
>
> (c) would create *fate accompli* and may cast shadow on the equitable share of State of Orissa in the waters of Inter-State river Vansadhara and its valley.
>
> iii. the acts and omissions of the Government of the State of Andhra Pradesh in

unilaterally undertaking the construction of the above flood flow canal (a); and

iv. the failure of the Government of the State of Andhra Pradesh to implement the terms of the Inter-State agreements, understandings, etc. relating to the use, distribution and control of the waters of Inter-State river Vansadhara and its valley."

4.11 The complaint also outlined the specific matters in the dispute in Para 5 of the complaint whereas Para 6 dealt with the matters connected with or relevant to the water dispute. Both paragraphs, 5 and 6, are extracted herein below:

"5. Specific matters in the Dispute:

The following water disputes, inter alia, would arise for adjudication and consequent decision of the Tribunal:

(a) On a fresh scientific assessment, what is the entire quantity of available water in the Inter-State river Vansadhara and its valley at Katragada and Gotta barrage?

(b) Should the States of Orissa and Andhra Pradesh share equally ("fifty : fifty basis") the entire quantity of water available in the Inter-State river Vansadhara and its valley – as agreed to earlier in 1962?

(c) Whether the State of Orissa and its inhabitants would be (or likely to be) affected prejudicially by the executive action of the Government of the State of Andhra Pradesh in constructing the flood flow canal to divert water from the Inter-State river Vansadhara at Katragada located on the Inter-State border?

(d) Whether the acts and omissions of the Government of the State of Andhra Pradesh are in

breach of the Inter-State agreements, understandings, etc. with regard to Inter-State river Vansadhara and its valley?

6. Matters connected with or relevant to the water dispute

The matters connected with or relevant to the water dispute which would arise for adjudication and consequent decision of the Tribunal, inter alia, are:

(a) Whether an Inter-State Body is necessary and appropriate to regulate the shares of the respective States in the waters of Inter-State river Vansadhara and its valley?

(b) Whether the State of Andhra Pradesh should be stopped from starting the construction of flood flow canal as agreed to in the Inter-State meeting held on 24.2.2005?

(c) What provisional and interim measures are necessary to protect the interests of the State of Orissa and its inhabitants in the waters of Inter-State river Vansadhara and its valley?"

4.12 Despite filing of the aforesaid complaint before the Central Government for necessary action, further negotiations and discussions between the two States continued even thereafter. Subsequent thereto, the CWPRS, Pune conducted the physical model studies for the side weir at Katragada and submitted its Technical Report No.4459 in July, 2007. The above-mentioned study for side weir concludes that for low flows as well as high flows in the river, flow conditions with and without side weir were almost similar. The aforesaid studies were conducted pursuant to the discussions in the inter-State meeting held on 24.4.2006 but the State of Odisha filed before the Hon'ble Supreme

Court of India a Writ Petition under Article 32 of the Constitution of India, wherein the Government of India has been made Respondent No.1 and the State of Andhra Pradesh was made Respondent No.2, seeking for the following reliefs:

> *"(a) direct the Government of India to constitute an appropriate Tribunal under Section 4 of the Inter-State Water Disputes Act, 1956 and thereafter, refer to it the dispute relating to the construction of Side Channel Weir and Flood Flow Canal Project at Katragada on River Vansadhara by the State of Andhra Pradesh;*
>
> *(b) issue a writ of mandamus commanding the State of Andhra Pradesh to forbear from carrying on any works of the proposed project;"*

4.13 Notice was issued on the said Writ Petition and after service of the same, the Government of India entered appearance. Respondent No.2, the State of Andhra Pradesh, also entered appearance and filed its reply. On completion of the pleadings in the said Writ Petition, arguments were heard by the Hon'ble Supreme Court. After conclusion of the arguments, the Hon'ble Supreme Court passed its order on 6th February, 2009 allowing the Writ Petition and directing the Central Government to constitute a Water Disputes Tribunal within a period of six months from the date and to refer to it the dispute relating to the construction of the side channel weir and flood flow canal project at Katragada on river Vansadhara by the State of Andhra Pradesh for diversion of the waters of the said river which could adversely affect the supply of water from the said river to the State of Odisha. The Hon'ble Supreme Court also passed an order of maintaining status quo as of date with regard to the construction of the side channel weir and flood

flow canal at Katragada pending constitution of the Water Disputes Tribunal with a liberty to the parties to apply for further interim orders before the Tribunal.

4.14 While allowing the Writ Petition, the Hon'ble Supreme Court, in paragraph 41 observed that in principle the two States had agreed to the sharing of Vansadhara river waters on an equal basis and that the Supreme Court was called upon to decide as to whether the diversion of a portion of the river waters into a side channel weir and a flood flow canal violates the said agreement and if it does, whether the same would amount to a water dispute between the two States. After considering the various aspects, including the resolutions taken in the various meetings between the two States, it was held that it is evident that the Union of India, to whom the complaint had been made by the State of Odisha on 14.2.2006, had made attempts to bring about a negotiated settlement between the two States which did not materialise and whereas the complaint made by the State of Odisha remained pending and, on the other hand, the construction of the side channel weir and the flood flow canal and the Neradi barrage had continued. Since there was delay of about three years from the date of filing of the complaint in taking concrete steps and action in the matter, the prayer of the State of Odisha was accepted. While allowing the said prayer, the Hon'ble Supreme Court observed that:

> *".....the prayer made by the State of Odisha does not appear to be unreasonable since the dispute between the two States does not confine itself to the construction of the side channel weir and the flood flow canal, but primarily it involves the unilateral decision taken by the State of Andhra Pradesh to divert the river*

waters to the State of Andhra Pradesh, which could possibly disturb the agreement to share the waters of the river equally."

4.15 Consequently, such dispute was held to be a water dispute and a direction was issued for constitution of a Water Disputes Tribunal within six months from the date.

4.16 Immediately after disposal of the aforesaid Writ Petition by the Hon'ble Supreme Court, the State of Andhra Pradesh also filed a complaint under Section 3 of the Inter-State River Water Disputes Act, 1956 referring to its proposal with regard to the construction of Neradi barrage on the inter-State river Vansadhara. It was stated in the said complaint that both the riparian States had agreed on several issues like sharing of water of river Vansadhara, location of the barrage at Neradi, the extent of submergence and backwater effect due to construction of the Neradi barrage and that after arriving at the aforesaid agreement, the State of Odisha raised certain unsustainable objections regarding construction of the Neradi barrage. In the complaint, the State of Andhra Pradesh has given the background facts regarding the proposal for construction of the Neradi barrage at Neradi and it also referred to the various resolutions that were taken at several meetings held between the two State Governments. It also gave an account of the results of the mathematical model studies as also of the physical model studies conducted by the CWPRS, Pune. Then it referred to the facts regarding the construction of side weir at Katragada and the circumstances under which the same was proposed to be constructed. The said facts have already been mentioned at earlier stages and,

therefore, they are not being repeated here for the sake of brevity. The grievances of the complainant and specific matters in dispute are outlined in para (III) and para (V), which are extracted hereunder:

> ***"III. Grievances of the complainant:***
>
> *19. In view of the above stated facts and circumstances and in view of the fact that the State of Orissa is not honouring the binding Inter State agreements, the State of Andhra Pradesh and its inhabitants could not derive the benefits due from proposed Neradi Barrage. The State of Orissa is objecting to the construction of Neradi barrage on some pretext or the other, which are neither legal nor proper, and had resulted in the following, prejudicial to the interests of the State of Andhra Pradesh and its inhabitants.*
>
> *a) Due to the non co-operation of the State of Orissa, the construction of barrage at Neradi by the State of Andhra Pradesh could not be proceeded with for the last 45 years and could not realize the benefits of drinking water from the Neradi barrage and Agriculture in this area could not be developed. On the other hand precious water resources are wasted in the Bay of Bengal year after year.*
>
> *b) Apart from depriving the benefits to the inhabitants of Andhra Pradesh from the said barrage, the cost of construction of the said barrage and related infrastructure, has increased from Rs.75 crores to Rs.1000 crores."*
>
> ***"V. Specific matters in dispute:***
>
> *21. the following specific matters, inter-alia would arise for adjudication by the Tribunal:*

a) Whether the conduct of State of Orissa is justified in its non co-operation to implement the binding terms of the Inter State Agreements relating to the construction of a barrage at Neradi across the river Vansadhara, an inter-state river?

b) The mathematical and physical model studies conducted by premier organizations of the country Central Water Commission (CWC) and Central Water Power Research Station (CWPRS), Pune, respectively found that the backwater effect in the event of construction of a barrage at Neradi, is well within the limits as agreed upon by the parties and in the light of the said finding, whether the State of Orissa can object to the construction of Neradi Barrage.

c) The water availability in river Vamsadhara need to be assessed afresh based on the fresh data for utilization of Andhra Pradesh's share in new projects in the future."

4.17 It was also stated in the complaint that efforts were made to settle the contentions of Orissa and that negotiations have taken place for resolution of the dispute amicably and, therefore, the issue regarding construction of the Neradi barrage is also required to be resolved by the Tribunal.

4.18 Upon receipt of the Order passed by the Hon'ble Supreme Court and also upon receipt of the complaints filed by the State of Odisha and State of Andhra Pradesh, the Central Government, in terms of the provisions of Section 4 of the Inter-State River Water Disputes Act, 1956, constituted a Tribunal by issuing a Notification dated 24th February, 2010. In the said Notification, it was stated that a request has been received under Section 3 of the Inter-State Water Disputes Act

from the Government of Odisha to refer the water dispute regarding the inter-State river Vansadhara, and the river valley thereof, to a Tribunal for adjudication. The Notification also refers to the direction of the Hon'ble Supreme Court in its Orders dated 6th February, 2009 and 24th November, 2009 directing the Central Government to constitute a Water Disputes Tribunal and refer to it the said dispute. Therefore, in exercise of powers conferred by Section 4 of the said Act, the Central Government constituted a Water Disputes Tribunal called "The Vansadhara Water Disputes Tribunal" for the adjudication of the said dispute, consisting of the following Members nominated in this behalf by the Chief Justice of India, namely:

i) Shri Justice B.N. Agrawal
Retd. Judge of the Supreme Court of India - Chairman

ii) Mr. Justice Nirmal Singh
Retd. Judge of the High Court of
Jammu and Kashmir - Member

iii) Mr. Justice B.N. Chaturvedi
Retd. Judge of the Delhi High Court - Member

4.19 However, as Shri Justice B.N. Agrawal submitted his resignation from the post of Chairman of the said Tribunal, the Ministry of Water Resources, Government of India, issued a fresh Notification on 30th March, 2011 by reconstituting the Tribunal with Dr. Justice Mukundakam Sharma, a Judge of the Supreme Court, as its Chairman. Thereafter, Mr. Justice Nirmal Singh, one of the Members of the Tribunal resigned from his post and, therefore, a fresh Notification was issued on 8th May, 2012 reconstituting the Tribunal with Mr. Justice Ghulam Mohammed, retired Judge of the High Court of Andhra

Pradesh, as Member in place of Mr. Justice Nirmal Singh. The Vansadhara Water Disputes Tribunal was thus fully constituted. But despite such constitution, there were some teething problems in making it functional and consequently the effective date of constitution of the Tribunal was ordered to be treated as 17th September, 2012, through a notification issued by the Central Government on 14th March, 2014, in pursuance of Supreme Court order dated 13th December, 2013.

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5

HEARING OF THE PROCEEDINGS IN THE TRIBUNAL

5.1 After constitution of the Tribunal by the Central Government and the reference of the water dispute between the States of Odisha and Andhra Pradesh by the Central Government to this Tribunal regarding inter-State river Vansadhara for adjudication as required under Section 4 of the Inter-State River Water Disputes Act, 1956, the first hearing by the constituted Tribunal could be held only on 9.9.2010 as no infrastructure for holding the sitting of the Tribunal could be made available by the Central Government, and instead a suggestion was given by the Ministry of Urban Development under letter dated 20.5.2010 expressing its inability to provide any government accommodation for the office of the Tribunal and therefore, a request was made by the said Ministry to the concerned Ministry namely – the Ministry of Water Resources - to make arrangement for taking private accommodation on rent.

5.2 As the process of making accommodation for establishing the office of the Tribunal was taking time therefore, the Tribunal decided to have an initial sitting in the Conference Hall of the Central Water Commission. Such an urgent meeting was also necessary in view of the fact that two interim applications were filed by the respective States. The State of Odisha filed an interim application praying for continuation of the interim order passed by the Supreme Court by ordering maintenance of the status quo with regard to the proposed

construction of Katragada Side Channel Weir and the Flood Flow Canal, which was registered as I.A. No.1/2010. The second application was filed by the State of Andhra Pradesh and registered as I.A.No.2/2010 praying for an interim order directing the State of Odisha to provide to the State of Andhra Pradesh immediately 106 acres of land to enable the State of Andhra Pradesh to undertake the necessary preliminary and preparatory works relating to the construction of Neradi Barrage on Vansadhara river.

5.3 After hearing the counsel appearing for both the States the Tribunal issued notice on both the applications filed by the respective States with a direction to file their counter affidavits and also for filing the rejoinders. Despite objection for passing an interim order at that stage raised by the State of Andhra Pradesh, the Tribunal passed an interim order directing the State of Andhra Pradesh to maintain status quo as of that date with regard to the construction of Side Channel Weir and the Flood Flow Canal at Katragada. The parties were also directed to file their Statement of Claims along with the necessary supporting documents along with a further order to file answer statements and thereafter rejoinders. The interim applications were directed to be listed for consideration on 23rd November, 2010.

5.4 However, on 23rd November, 2010 when the Tribunal assembled for consideration of the interim applications in terms of the order passed earlier, it was found that only counter affidavits to the respective applications had been filed and that rejoinders were not filed by the respective parties. Accordingly, further time was granted to the parties to file their respective rejoinders. The parties were also directed

to file the Statement of Claims, the reply statements as also the rejoinders. The matter was directed to be listed on 1st February, 2011 for further hearing. The Tribunal also recorded that it expected availability of a permanent space for holding the sitting of the Tribunal which should be arranged by the Central Government. However, subsequent thereto Justice Shri B.N.Agrawal, the then Chairman of the Tribunal submitted his resignation and therefore, the matter could not be taken up on 1st February, 2011 as scheduled. Subsequent thereto Justice Dr. Mukundakam Sharma was nominated as the Chairman of the Tribunal in place of Justice Shri B.N.Agrawal who submitted as aforesaid his resignation and was so substituted. Subsequent thereto even Mr. Justice Nirmal Singh, a Member of the Tribunal also submitted his resignation and in his place Mr. Justice Ghulam Mohammed was nominated as a Member of the Tribunal. However, his appointment as a Member of the Tribunal came to be challenged by the State of Odisha on the ground of conflict of interest before the Tribunal which was registered as I.A.No.5/2012. Since the aforesaid application was filed, the same was required to be taken up with priority as the other two applications could be taken up only after a decision was taken by the Tribunal on the said application registered as I.A. No.5/2012.

5.5 Counsel appearing for the parties were heard on the said application registered as I.A. No.5/2012 on 3rd October, 2012. After the conclusion of hearing of the arguments of the counsel appearing for the parties the Tribunal was of the opinion that the Tribunal does not have any inherent power to decide the issue raised as the appointment of the learned Member was made by the Central Government on the

basis of nomination made by the Hon'ble Chief Justice of India and therefore, the remedy of the State of Odisha is elsewhere and not before the Tribunal as the Statute does not empower the Tribunal to Rule on the issue posed before the Tribunal. The application was therefore, not entertained and was rejected.

5.6 On the same date the Tribunal also passed a procedural order for completion of the pleadings in the reference made by the Central Government and a direction was issued that the matter shall be listed along with the pending applications for consideration on 4th and 5th of December, 2012. However, the matter was again adjourned on 4th of December, 2012 as the State of Odisha filed an application for adjournment which was granted. The aforesaid applications – I.A. No.1/2010 and I.A. No.2/2010 were taken up for consideration on 14th March, 2013 during the course of which I.A. No.1/2010 was heard in part. The said application was heard on different dates. During the course of arguments the counsel appearing for the applicant/State of Odisha drew our attention to the statements made in the application to the effect that while the parties were negotiating and discussing to find out a solution with regard to the construction of Neradi Barrage, the State of Andhra Pradesh unilaterally took a decision for construction of the Side Channel Weir at Katragada without even consulting or discussing with the State of Odisha or intimating such a decision to the Central Water Commission. Consequently, the application was filed seeking for interim relief of maintaining status quo with regard to such construction in terms of similar order which was passed by the Hon'ble Supreme Court while disposing of the writ petition. It was stated in the

application that as the State of Andhra Pradesh has taken such a unilateral decision for construction of Side Weir with Flood Flow Canal to divert the water by cutting the right side of the bank of river Vansadhara at Katragada and once the said construction is completed, it will naturally facilitate free flow of water by gravity into the flood flow canal. The apprehension of the State of Odisha is that in that event the water would start flowing into the canal consequently drying up the existing river bed downstream of Katragada. Reference was also made to the pleadings in the application, to the statement made in the complaint made by the State of Odisha with the Central Government to the effect that such diversion of water from the Side Weir in the Flood Flow Canal would substantially deprive the existing irrigation of 30,000 acres of Odisha lying on the left bank of river Vansadhara – downstream of Katragada. It was apprehended that in that event 18 villages of Odisha lying on the left bank will also be substantially deprived of the drinking water and other requirements including requirements of flora and fauna particularly during the non-monsoon months. It was also stated in the said application that the ground water table would also be affected resulting in possibility of the river flow diverting towards the right bank and sand cast would occur in the left bank towards Odisha leading to morphological changes and environmental changes shifting the river from present channel towards the flood flow canal. In that view of the matter it was stated in the application that such diversion, if allowed to take place due to the construction of the Side Weir and the Flood Flow Canal would enable the State of Andhra Pradesh to draw water in excess of its share and that would be highly prejudicial to the rights of the riparian State like the State of Odisha. It was stated that

they have a strong prima facie case and that the balance of convenience was in favour of restraining the State of Andhra Pradesh from constructing the Side Weir with Flood Flow Canal at Katragada.

5.7 The State of Andhra Pradesh filed its reply denying the allegations made in the application and contended inter-alia that all the allegations made are untrue and untenable. It was contended that the Detailed Project Report of Vansadhara Phase II Stage II which includes construction of the Side Weir was sent to the State of Odisha at its request somewhere in the year 2006 which clearly shows that the Side Weir is a temporary measure, which when operated would cause the river water spilling out into the pond over the Side Weir only when the flow in the river is above 4000 Cusecs, and that there would be no drawal of water from the river till it crosses 4000 Cusecs. It was further stated in its reply that the design and parameters of the Side Weir are so clear that there would be no drawal through the Side Weir so long as the flow is only 4000 Cusecs or below. It was also pointed out that in the best hydrologically favourable conditions, the Side Weir can and would draw water for only 55 days and drawals vary from 0 to 6500 cusecs in those days. It was also pointed out that a theoretical drawal of about 8 TMC would be possible only during the aforesaid 55 days and that atleast 80 TMC would flow down the river below Katragada as unutilized into the sea and therefore, no prejudice would be caused to the State of Odisha.

5.8 On the basis of the aforesaid pleadings, the counsel for the applicant/State of Odisha reiterated all the statements made in the application. Counsel for the State of Odisha during his submissions also

referred to the Inspection Report prepared by the Tribunal wherein it is recorded about the observance of sedimentation upstream of Gotta Barrage which could also take place if the Neradi Barrage is constructed. He also relied upon the creation of an island on the bed of the river like a mound because of such sedimentation in Vansadhara river. The further submission of the counsel was that injunction for maintenance of status quo in respect of construction of the Side Weir and the Flood Flow Canal was continuing for four and a half years after the same was passed by the Hon'ble Supreme Court and if the said order of injunction is vacated the complaint filed by the State of Odisha itself would become infructuous. The counsel also drew our attention to the bend of the river at the site where Side Weir is proposed to be constructed. Emphasising on the course on the river taking a bend at that point it was the submission that the entire water of the river would resultantly flow through the Side weir and Flood Flow Canal thereby making the river dry towards the side of the State of Odisha.

5.9 Mr.C.S.Vaidyanathan, Senior Counsel appearing for the State of Andhra Pradesh, however, submitted that only 8 TMC of water would be proposed to be drawn through the said Side Weir and Flood Flow Canal and even if the same is allowed, on an average 0 to 6500 cusecs of water would be drawn in those days. It was also submitted that there is no existing irrigation project of the Government of Odisha at the site of Katragada as also of at Neradi and the requirement of water so far as the State of Odisha is concerned as is clear from the facts placed on record, could only be about 4 TMC. The counsel also highlighted the fact that construction of a Side Weir and the Flood Flow

Canal have been proposed only because there is a delay of about 45 years in allowing construction of the Neradi Barrage, the construction of which even the State of Odisha agreed and in that regard inter-State agreement was executed defining the scope and method of construction which was agreed upon. Since the construction of Neradi Barrage is not permitted and is still under process of discussion, therefore, as an alternative and as a stop gap arrangement such a Side Weir is proposed to be constructed so that volume of 8 TMC of water could be taken through the Flood Flow Canal for the purpose of irrigation and drinking water for the people in Andhra Pradesh.

5.10 After hearing the rival submissions of the counsel appearing for the parties, pronouncement of the order was reserved. Subsequently by a detailed order passed on 17th December, 2013 the application filed by the State of Odisha was rejected holding that the State of Andhra Pradesh has been able to establish a prima facie case in their favour and also to establish that balance of convenience is on their side and also that they would suffer irreparable loss and injury, if the Side Weir was not allowed to be constructed, for the State would be deprived to utilise that quantity of water for irrigation and other ancillary purposes. So far as the apprehensions pointed out by the State of Odisha regarding various factors and on different counts are concerned the same were found to be baseless and reasons for the same have been explicitly recorded in the order itself. By the said order the Tribunal allowed the Government of Andhra Pradesh to construct the Side Channel Weir alongwith the ancillary works at Katragada as

proposed but with certain conditions which are enumerated in para 53 of the order which read as follows:

> *"(i) A Supervisory Flow Management and Regulation Committee consisting of three members – one from the Central Water Commission; one from the State of Andhra Pradesh; and one from the State of Orissa with the member/representative from the Central Water Commission acting as the Chairman of the Committee, shall be constituted to supervise the construction as also functioning of the Side Weir and also for implementation of the order of the Tribunal;*
>
> *(ii) The Project proposal must get clearance from the Central Water Commission, Ministry of Water Resources, Ministry of Environment and Forest, Ministry of Tribal Welfare and other statutory clearances as would be required;*
>
> *(iii) The Supervisory Committee shall supervise the operation of the gates of the Side Channel Weir including the closure of the same;*
>
> *(iv) The Committee shall select the place for its office which shall be provided by the State of Andhra Pradesh. The expenses for the maintenance of office and all expenses for conducting the monitoring activity would be borne by the State of Andhra Pradesh;*
>
> *(v) The Committee shall maintain the record of the flow upstream of the Side Channel Weir and that passing through the side channel Weir. The Committee shall permit the opening of the gate only when the flow in the Vansadhara river upstream of Side Channel Weir exceeds 4000 Cusecs and the flow downstream of the Side Channel Weir is equal to or more than 4000 Cusecs;*
>
> *(vi) The Committee shall ensure that total spill from the Side Channel Weir during the months of June to November in any year would not in any case exceed*

8 TMC, constituting a part of 50% share of water of State of Andhra Pradesh;

(vii) The Committee would also ensure that during the period from the month of June to November the gates would be closed as soon as the spill over from the Side Channel Weir equals to 8 TMC and it shall so remain closed till the next monsoon year;

(viii) The gates of the Side Channel Weir would remain closed during Ist of December to 31st of May so that the entire water flowing through the Vansadhara river could flow down the river for use by both the States;

(ix) That the Committee should also ensure that if there be any silting or sedimentation near the gate of the Side Weir same should be got cleared through the staff and the agency of the State of Andhra Pradesh every year after the monsoon.

(x) The Committee shall also make a periodical survey, as it deems necessary, on the alleged issue of aggradation and degradation and take appropriate steps thereto and to ensure that the bed level of the Side Weir at all times shall be as per its original design."

5.11 With the aforesaid observations and directions the interim application filed by the State of Odisha (I.A. No.1/2010) was disposed of. A copy of the order dated 17.12.2013 passed on I.A. No.1/2010 is placed as Appendix-5 in Volume-III (APPENDIXES).

5.12 So far as the application registered as I.A. No.2/2010 is concerned, as the same pertains to the issues that arise for consideration in the main reference, the consideration of the same was deferred.

5.13 After passing of the aforesaid order by the Tribunal, the State of Odisha chose to file a Special Leave Petition before the Hon'ble Supreme Court challenging the legality and validity of the said order dated 17.12.2013. The Hon'ble Supreme Court by order dated 17.02.2014 issued notice on the said Special Leave Petition but did not pass any order of stay. In that view of the matter and since no stay order was passed by the Supreme Court the proceedings were continued. The said Special Leave Petition is pending consideration and disposal as of today.

5.14 The Tribunal thereafter, in view of the completion of the pleadings of the parties in respect of the reference proceeded to frame issues in the proceedings which arise for consideration. The following issues were framed finally in the proceedings in the presence of the parties:

> 1. Whether, the reference dated 19.03.2010 of the Union of India, under Section 5(1) of the Inter State River Water Disputes Act, 1956 with regard to the water disputes emerging from the complaint dated 28.07.2009 filed by the State of Andhra Pradesh is not maintainable?
>
> 2. Whether the State of Odisha is justified in objecting to or delaying the Neradi Barrage by not honouring the binding Inter-State Agreements and not allowing the construction of Neradi Barrage.
>
> 3. Whether the State of Odisha is not obliged to make available the agreed extent of 106 acres of land to the State of Andhra Pradesh for the construction of the Neradi Barrage having agreed to do so as far back as in 1961?

4. Whether the State of Odisha is justified in stating that the land required for acquisition should be confined to 106 acres, on account of the Neradi Barrage, as initially agreed, when they insist on additional protective measures like embankments etc., on its side on account of the 1980 flash floods?

5. Whether the construction of Neradi barrage by the State of Andhra Pradesh across Inter State River Vansadhara is subjected to any agreed conditions? If so, whether the agreed conditions are the following:

(i) That the submergence in the territory of Odisha shall be limited to 106 acres excluding the river bed in the State of Odisha; and

(ii) That the back water effect shall be limited to 3 Km. upstream of the barrage both in non-silted and silted conditions.

6. Whether the back water effect of the Neradi barrage as planned by the State of Andhra Pradesh goes beyond 3 km from the barrage upto Gunupur and whether the State of Andhra Pradesh has no legal right to cause submergence or back water effect in the territory of the State of Odisha without its consent?

7. Whether the State of Odisha is not barred from undertaking projects under which it has been proposed/proposing to unilaterally divert the waters of Inter State River Vamsadhara to another basin jeopardizing the basin requirements of river Vamsadhara?

8. Whether the State of Odisha is justified in objecting to the drawal of waters by the State of Andhra Pradesh through Side Weir especially when the proposed drawal is within its territory and share and whether the State of Andhra Pradesh is bound to take the consent of the State of Odisha before execution of the Side Weir Project on the right bank?

9. Whether the Side Weir as proposed by the State of Andhra Pradesh would in any way adversely affect any interests of the State of Odisha in the downstream of Katragadda?

10. Whether the drawal of waters through Side Weir as proposed by the State of Andhra Pradesh would in any way diminish the share of waters of the State of Odisha?

11. Whether, the Side Weir at Katragada planned by the State of Andhra Pradesh to divert water from the right bank of the Inter-State river Vansadhara is likely to change or alter the Inter-State border in the common reach of the river below Katragada and if so, is the above material issue for consideration by this Tribunal in the context of the present dispute?

12. Whether the Side Weir at Katragada planned by the State of Andhra Pradesh to divert water from the Inter-State river Vansadhara is likely to affect the morphology of the river Vansadhara in the downstream reach of Katragada due to aggradation of the river bed caused by siltation and if so, whether the above is a material issue for consideration by the Tribunal in the context of the present dispute?

13. After the construction of the Side Weir at Katragada by the State of Andhra Pradesh, will there be any material change in volume or pattern of flows on the left bank of the river falling in the territory of the State of Odisha? If so, will it adversely affect the existing water requirement of the inhabitants in the State of Odisha?

14. Whether an Inter-State regulatory body is necessary for implementation of the decision to be given by this Hon'ble Tribunal?

15. To what relief?

5.15 After framing of the issues in the aforesaid manner, the parties were allowed to lead evidence by filing their affidavits by way of examination-in-chief but a direction was issued that the witnesses who file their affidavits by way of evidence in the nature of examination-in-chief would have to be present before the Tribunal for their cross-examination. Consequent thereto the State of Odisha filed affidavits by way of examination-in-chief of four witnesses whereas the State of Andhra Pradesh filed affidavits by way of evidence in the nature of examination-in-chief of two witnesses. Thereafter the matter was directed to be listed for cross-examination of the witnesses who were so cross-examined. The oral evidence adduced by the parties is being dealt with and analysed in the next chapter.

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6

NATURE OF ORAL EVIDENCE ADDUCED

6.1 In terms of the direction issued on 17th December, 2013, both the parties filed their list of witnesses. The State of Odisha had given a list with the names of four witnesses to be examined on behalf of State of Odisha whereas the State of Andhra Pradesh had submitted a list of witnesses with three names. In terms of the order dated 22nd January, 2014, the State of Odisha has filed affidavits by way of evidence in the nature of examinationI-in-chief of four witnesses. They have also filed all the documents which they seek to rely upon and have been marked exhibits. The State of Andhra Pradesh has filed Affidavits by way of examination in chief of the first two witnesses mentioned in their list of witnesses filed on 22.1.2014. On 25th September, 2014, it was stated by the counsel appearing for the State of Andhra Pradesh that they want to drop the third witness named in that list, with a liberty to file affidavits of additional witnesses, if any, on or before the next date. The State of Andhra Pradesh was permitted to file Affidavits by way of evidence of additional witness, if any, with advance copy to the counsel appearing for the State of Odisha.

6.2 Mr. R.C. Tripathy was cross-examined as the first witness on behalf of the State of Odisha on 25.11.2014, 26.11.2014, 17.3.2015 and 18.3.2015 by Mr. C.S. Vaidyanathan, learned Senior Counsel for the State of Andhra Pradesh. His affidavit as witness in examination-in-chief and cross-examination is summarized below:

AFFIDAVIT

6.2.1 Mr. Tripathy in his affidavit has mainly dealt with the impact of the proposed side weir at Katragada.

6.2.2 Referring to the complaint of Government of Odisha, he has stated that the executive action of constructing side weir at Katragada, would deprive drinking water requirements of about 18 villages and irrigation requirements of 30,000 acres of land and would also result in drying up the existing river bed thereby affecting ground water table and casting a shadow on the equitable share of Odisha in the waters of Vansadhara.

6.2.3 He has stated that the major factors governing a river regime and sediment transporting capability of the river water depends on velocity of flow, river bed characteristics and sediment grade and sediment charge of the flow. During high flood, a sudden decrease in quantum due to diversion at Katragada side weir will result in reduction of flow in the main stream and consequent deposition of sediment on the downstream side. Due to such aggradation the stage discharge relationship of the river will undergo changes. As such the concept of diverting only the flood flow in excess of 4000 cusecs in the river will not hold good.

6.2.4 He has also pointed out that in case the proposed barrage at Neradi is constructed, aggradation of the river bed upto the crest level of the barrage will take place within a very short time span of 2 to 3 years and the proposed Katragada side weir will always remain

submerged, thereby drawing higher quantum of water than predicted at this stage.

6.2.5 He has also stated that the proposed quantum of 8 TMC can be lifted from Gotta barrage to Hiramandalam. This lifting proposal seems to be techno-economically viable and Andhra Pradesh can drop the proposal of side weir.

6.2.6 In order to ensure drawal of quantity of water required for domestic, irrigation and environmental needs, the minimum depth of flow is always to be maintained in the river during monsoon period. Odisha has suggested 8000 cusecs in its submissions. In case, the side weir is constructed this flow would be deprived causing injury to the irrigation and other needs on the left bank in Odisha. Using HEC-RAS Mathematical Model, the water depth available and the distance of water from the bank has been made estimated and enclosed as graphs and tables in the affidavit.

CROSS-EXAMINATION

6.2.7 Mr. Vaidyanathan, Senior Counsel for the State of Andhra Pradesh, asked the witness about the average flows of the river Vansadhara at Kashinagar, which is the last point of measurement of the flows of River Vansadhara in the State of Odisha to which Mr. Tripathy showed his inability to answer but gave an approximate idea that during the rainy season the peak flow near Kashinagar varies from year to year but during the summer months the flow is very low. Pointing out to Exhibit OW-1/1 when he was questioned whether it would be correct to say that the average flow at Kashinagar is around

85 TMC and that the bulk of utilization in the State of Andhra Pradesh is below Kashinagar, he replied in affirmative. In response to the question, regarding utilization of water in the State of Odisha, he stated that mostly, it is above Kashinagar but the State of Odisha is planning to utilize its water along the boundary at several places below Kashinagar. He was unable to quantify the estimated utilization referred to in his affidavit and stated that the water requirement for irrigation, drinking water and livestock may be 5.49 TMC but that does not include all the water requirements for that area.

6.2.8 On a query put by learned counsel, Mr. Tripathy stated that Andhra Pradesh has planned for drawal of 8 TMC of water at Katragada. He did not agree to the suggestion of learned counsel that the drawal of 8 TMC of water at Katragada would not affect the requirement below Katragada in the State of Odisha since the flow on an average is about 80 TMC at that point. Mr. Tripathy further replied that the information given in para 6 of his affidavit, which he collected from various documents, is based on the water requirement for the crops of the cultivable area and showed his inability to compute the water requirement for irrigation purposes for an extent of 5523.81 hectares (13641 acres) cultivable area below Katragada on the left side of Vansadhara in Odisha. When asked about the nature of study conducted to assess the specific water requirement of the areas in Odisha below Katragada, Mr. Tripathy replied that his studies were based on the impact that is likely to be created on construction of the proposed side weir near Katragada, the necessity of this abstraction and the impact that is likely to have on the overall river regime which

includes the negative impact the proposed Neradi Barrage is likely to have in Odisha and the deprivations that the downstream areas in Odisha are likely to suffer. According to him, irrigation and domestic requirements are only a part of the water requirements which can keep the downstream area environmentally healthy and may meet the various other requirements of the region.

6.2.9 To a query raised by learned counsel for the State of Andhra Pradesh regarding any independent study carried out by him for determining the flow required to meet the needs of Odisha below Katragada, he responded that the study included the overall requirement of the area i.e. irrigation usage, domestic requirement, maintenance of flow regime in the river, requirement for the river to purify itself, maintenance of aquatic bio-diversity, recharging of ground water, supporting livelihood of the surrounding areas, maintaining the sediment movement, allowing the river to meet the natural and religious needs of the people, and for prevailing recreation. He further added that industrial requirements were also to be kept in mind for existing and proposed industries.

6.2.10 Referring to para 8 of the affidavit, Mr. Tripathy was asked to explain the expression “sudden decrease in quantum” to which he stated that he had visited the Katragada site and seen that the upstream side of the river enters the area at almost right angles and that during high floods of all magnitudes, there would be a tendency of the river to flow straight and whatever discharge is taken through the side weir would be reduced from the main flow in the river and that would have repercussions on the regime of the river downstream.

6.2.11 To a query raised by learned counsel, Mr. Tripathy answered that as per Annexure-A to the rejoinder dated 14.8.2013, the average number of days in a year when the discharge in river Vansadhara exceeded 12000 cusecs was 18 and the maximum was 65. He did not dispute the statement of the counsel that the average number is only 5 when the flow in Vansadhara exceeds 50,000 cusecs. Further in response to the issue raised by the counsel of Andhra Pradesh that the drawal through Katragada Weir is only maximum of 6400 cusecs as against maximum of 50,000 cusecs in river to have any significant impact on deposition of sediments, he mentioned that this phenomenon is a little complex to be put so simply as a ratio of the flood flow of 50,000 cusecs; he believed that the flood flow channel was designed for discharge of 8000 cusecs and that even when the flow during monsoon months in the river at Katragada was much less than 50000 cusecs, the silt load and the silt charge in the river would be upset after there is a diversion through Katragada side weir and there would be sedimentation on the downstream side and on the opposite banks also. To a suggestion that his apprehension on aggradation and siltation is hypothetical and that the interim order passed by the Hon'ble Tribunal on December 17, 2013 had addressed this apprehension, Mr. Tripathy denied the suggestion.

6.2.12 Referring to the proposed Sananadi River Project and the command area and the intensity of irrigation under the said Project, learned counsel strongly suggested that at no point of time the area in question had ever had cropping intensity of 275% and the water requirement indicated in paragraph 6 of the affidavit was highly

inflated. Mr. Tripathy did not agree to the suggestion stating that the intensity of 275% includes the necessities of the area and the demands of the farmers. Learned counsel examined the witness insofar as the 43 minor irrigation tanks below 80 metres contour as mentioned in item No.3(a) of Ex.OW-1/5 are concerned. Mr. Tripathy also agreed that these 43 tanks are not fed by the flows from the main river Vansadhara. As regards the impact on these minor irrigation areas by construction of the proposed side weir at Katragada and the Neradi barrage, the witness answered that though the existing minor irrigation schemes or tanks are not receiving any supplementation from the main river, but the requirements of the area are far more than what is available from the minor irrigation scheme or tanks, as such, if the Neradi barrage is constructed as proposed, or there is a diversion through the Katragada side weir, the water availability in the river would adversely affect the requirement of the area.

6.2.13 To a query put to him, Mr. Tripathy answered that the proposed Sananadi Project would take care of the irrigation requirement of all the 41 villages mentioned in the second list in para 6 of his affidavit but he was not sure if drinking water requirements would also cover all the 41 villages. Disagreeing with the suggestion of learned counsel that once the lower Vansadhara Project is implemented, the sediment which travels down to Katragada and Neradi would be considerably reduced, Mr. Tripathy stated that Sananadi dam intercepts only a part of the catchment and the reservoir would result in trapping of some of the sediments from the upstream side but the spillway discharge would also trap some of the sediments

from the downstream areas and the net result near Neradi barrage is not likely to be appreciable. He further replied to another query that once the lower Vansadhara project gets commissioned and is made operational the flows reaching Katragada and Neradi would be considerably reduced, more particularly during monsoon because once there is an interception in an upstream area, the flow pattern on the downstream generally undergoes change.

6.2.14 The witness denied the suggestion of learned counsel that there is no basis for Odisha requiring a flow of 8000 cusecs of water as stated by it in its rejoinder dated 14.8.2013 and as mentioned at para 15 of his affidavit. He added that unless the discharge of 8000 cusecs was available on the downstream of Katragada side weir, the river portion will dry up in several places and may result in further aggradation and scarce conditions for availability of potable water and for bathing purposes etc. on the downstream side thereby adversely affecting the entire area. He further answered to a query that the DPR did not specifically specify the number of days when water flow was more than 8000 cusecs but it indicated the number of days when water flow was more than 4000 cusecs, in the range of 4000-12000 cusecs and more than 12000 cusecs was available and that it may not be possible that the operational protocol for the reservoir to be constructed under the Lower Vansadhara project would ensure that the flow reaching Katragada would be more than 8000 cusecs. He mentioned that the requirement of 8000 cusecs was mostly for the riparian rights of the area downstream of Neradi barrage to the extent it is possible to maintain so and that the drinking water and irrigation

requirements are a part of the total requirement. Further the flows were also required for (i) maintaining flow regime, (ii) enabling the river to purify itself, (iii) maintaining aquatic bio-diversity, (iv) recharging ground water, (v) supporting livelihoods, (vi) maintaining sediment movement, (viii) allowing the river to meet the natural and religious needs of the people and (viii) for prevailing recreation.

6.2.15 Learned counsel also questioned him about the number of days during which presently the flow was above 8000 cusecs. Mr. Tripathy admitted that other than the information contained in Ex.OW-1/6, he had no knowledge of the number of days during which the flow in the river was more than 8000 cusecs. Learned counsel strongly suggested that the requirement of 8000 cusecs indicated by the witness and by the State of Odisha in Ex.OW-1/6 was deliberately inflated and was not required for sustaining environment of the river or other such requirements as mentioned by him to which Mr. Tripathy disagreed.

6.2.16 On further cross-examination, Mr. Tripathy did not agree to the suggestion of learned counsel that the construction of the proposed barrage at Neradi and the side weir at Katragada would not affect the interests of inhabitants of State of Odisha and the State of Andhra Pradesh below the said projects.

Thereafter, the cross examination of Mr. Ramesh Chandra Tripathy was concluded.

6.3 Mr. A.K. Padhi was the second witness examined on behalf of the State of Odisha. He was cross examined on 22.4.2015, 23.4.2015,

11.5.2015, 12.5.2015, 30.7.2015 and 19.8.2015. His affidavit as witness in examination-in-chief and cross-examination is summarized below:

AFFIDAVIT

6.3.1 Mr. Padhi in his affidavit has stated that the total gross cropped area in the territory of Odisha below Katragada and up to the inter-state border is 33280 acres. Projecting the total population of human and live stock in this territory to the year 2050, he has worked out the water requirement for irrigation, domestic and live stock as 5.49 TMC.

6.3.2 Through various tables and graphs prepared through a mathematical model (HEC-RAS), he has concluded that the flow of 8000 cusecs can create a depth of about 1.23 m which constitutes only about 19% of the total depth of the river. He has also stated that the flow of water of 4000 cusecs do not reach left bank of the river and therefore a large extent of land and people living on the left bank in Odisha would be deprived of water during monsoon months. He has also claimed that the entire flow of the river may find a way into the flood flow channel taking off from the side weir,

6.3.3 He has stated that river below Katragada is likely to suffer heavy aggradation after the construction of the side weir and if Neradi barrage is permitted to be constructed, the river is likely to suffer heavy sedimentation in the upstream. This would cause much higher back water effect than what has been estimated. He has also stated that the inter-state boundary line which is formed by the line drawn from the deepest points in the river may change due to the aggradation

of the river bed. He has also stated that the non-monsoon flows in the river are likely to be cut off after the construction of side weir at Katragada due to aggradation of the river bed.

Keeping all the above points in view, he has submitted that both side weir at Katragada and Neradi barrage planned by Andhra Pradesh are highly prejudicial to the interests of the State of Odisha and its habitants and therefore the Hon'ble Tribunal should restrain the State of Andhra Pradesh from constructing these structures.

CROSS-EXAMINATION

6.3.4 When enquired by the counsel for the State of Andhra Pradesh about the reasons as to why the proposed construction of side weir at Katragada and the proposed construction at Neradi barrage would be prejudicial to the interests of the State of Odisha and inhabitants of the State, Mr Padhi stated that apart from the two reasons mentioned in his affidavit namely, the requirement of Odisha of 5.49 TMC below Neradi Barrage could be met only if the discharge in the river is about 8000 cusecs and that the summer flows are likely to be cut off after the construction of the side weir at Katragada due to aggradation of the river bed and there are other reasons like construction of side weir at Katragada which would change the course of river completely.

6.3.5 Pointing out to the Chart showing average daily discharge data of river Vansadhara at Kashinagar G&D site in cusecs (Ex.OW-2/1), Mr. Padhi was asked to indicate the months during which the average flow is more than 8000 cusecs. To this he has stated that only in the

months of August and September, the average flow exceeds 8000 cusecs but, if the individual flows of different years are seen, at least more than 50% of time, the flows exceeds 8000 cusecs during the month of October also.

6.3.6 He was further cross-examined by giving a suggestion that his claim that the flow of 8000 cusecs in the river is required to meet the water requirement of Odisha of 5.49 TMC on the left bank of the river is incorrect, he denied the suggestion because 8000 cusecs would not only meet the requirement of 5.49 TMC but also for meeting other requirements.

6.3.7 Learned counsel for the State of Andhra Pradesh drew his attention to the fact that there are only 33 days in a year on an average during which the flow in the river is more than 8000 cusecs and suggested to Mr. Padhi that in the balance of 332 days, the flow is much less than 8000 cusecs as a result of such lower flows during these 332 days Odisha or its inhabitants would not suffer. Mr. Padhi replied that Odisha needs minimum flow of 40% for other purposes excluding its requirement of 5.49 TMC meaning thereby that whatever flow is available at Katragada or Neradi barrage site at a particular day or month, 40% of that flow should be allowed on the river in that common boundary.

6.3.8 While pointing out the statement made in his affidavit (last sentence of para 16), learned counsel cross examined Mr. Padhi as to whether he was suggesting that the flows will not continue in the river after the construction of side weir at Katragada to which Mr. Padhi answered in the negative but added that in most of the areas in the 29

km common boundary, the flow would be diverted towards Andhra Pradesh boundary thus depriving the flow towards Odisha boundary.

6.3.9 Mr. Padhi indicated that Odisha is having 31 numbers of public river lifts at present in the area adjacent to the 29 km common boundary. He denied the suggestion of the learned counsel that the public lift irrigation schemes to which a reference was made in the affidavit did not exist at least till December, 2014.

6.3.10 Mr. Padhi stated that sand mining was done in river Vansadhara in the reaches from Gunupur to the end of the common border between Odisha and Andhra Pradesh when he worked as Executive Engineer during the period 2001 to 2007, but whenever it was found that the sand mining might create problem to the other inhabitants of nearby villages, the Irrigation Department gave suggestion to the Revenue authority to change or stop sand mining at some places to ensure that the flows in the river were not affected.

6.3.11 During the cross-examination, he further stated that he had noticed during 2003 (when he was associated with Vansadhara River Basin) that there was a devastating flood and after analysis and field verification, it was felt that the flood was due to aggradation in the river at Kashinagar. Further, he agreed to the suggestion of the learned counsel that the flashes in the river upstream were not able to flow through the sections at the downstream of Kashinagar to Gotta Barrage. But, he was unable to recollect in which side of the river, aggradation took place at Kashinagar in the year 2003.

6.3.12 Learned counsel suggested to him that if the aggradation was on the left bank of the river, i.e., on Odisha side, some steps would have been taken for desiltation by the State. Mr. Padhi denied but suggested that if de-siltation or dredging was to be done at all, it should be from the downstream areas where the water gets unobstructed passage to flow freely.

6.3.13 He was further cross-examined on 23.4.2015 about the bed levels of cross section at Kashinagar for some of the years between 1975 and 2012 (Ex.OW 2/5 to 2/8) and the correction made in the year 1985-86 by CWC to the reduced level of zero gauge. He denied the suggestion that the aggradation or degradation in the bed level has nothing to do with the operation of the barrage at Gotta.

6.3.14 Referring to Ex. OW–2/6, the learned counsel pointed out that the bed closer to the left bank had both gone up and gone down and there was no consistent aggradation as claimed by Mr. Padhi. To this the witness agreed.

6.3.15 Mr. Padhi agreed to the suggestion of learned counsel that the statement in para 14 of his affidavit that "the above aggradation in 32 years from 1980 to 2012 varies from 0.6 metres to 2.5 metres" was without applying the correction factor in regard to the reduced level at zero gauge at Kashinagar made in the year 1985-86.

6.3.16 Mr. Padhi was further cross-examined about the design gradient of the side channel taking off from the proposed side weir at Katragada and the gradient of Vansadhara River. The gradient of the side channel was 1/12000 while that of the river ranged from 1/2571 to

as high as 1/686. In respect of the situation referred to in Mississippi river where the gradient was steeper in the branch channel as compared to the main channel resulting in greater inflow towards the branch channel, the counsel of Andhra Pradesh gave him a suggestion that the situation is exactly the reverse in respect of the channel taking off from the proposed side weir at Katragada and the illustration presented had no relevance to which Mr. Padhi did not agree.

6.3.17 Learned counsel had shown a satellite imagery of the river and the river bed in the areas around Katragada and a location marked 'A' and questioned the witness about the presence of alleged bend in the river at the site of the proposed Katragada weir. Mr. Padhi replied that he visited the place on 8.4.2015 and noticed that the location of proposed weir was on a bend where the entire flow on that day which was about 10.5 cumecs was hitting the side weir.

6.3.18 Replying to a query about the strengthening and raising of the embankments on the left side near about Neradi and Katragada and their design, Mr. Padhi stated that the embankments were designed and constructed keeping in mind the HFL during 1980 and also taking into consideration the moderate flood i.e. about 30000-40000 cusecs because the flow at 23000-24000 cusecs touches both the left and right banks. He further stated that average highest flow is about 40000 cusecs; hence, these embankments are designed and renovated keeping in view this flow of 40000 cusecs. He denied the suggestion of learned counsel that the existing flood banks would afford protection for much higher floods than indicated by him. He also denied the suggestion of learned counsel that areas referred to by him in para 4 of

his affidavit would receive irrigation supplies from left canal of Sananadi Dam when executed by saying that only some area below 78.0 m contour would receive irrigation supplies from the proposed left canal taking off from Sananadi Dam.

6.3.19 Referring to paragraphs 4, 5, 6 and 8 of his affidavit, Mr. Padhi was further cross-examined about the crop water requirements of the areas mentioned therein. He agreed that the crop water requirement mentioned in his affidavit was different from what had been worked out in the Lower Vansadhara Irrigation Detailed Project Report. To another query raised by learned counsel, Mr. Padhi answered that the 31 lift irrigation projects indicated in OW-1/5 were constructed by the State and subsequently they had been handed over to private beneficiaries through Pani Panchayats and at present they are considered as private lifts and he was unaware as to whether any records were kept by the Irrigation or the Revenue Department in regard to the quantum of water which was lifted through these projects. Mr. Padhi agreed to the suggestion of learned counsel that the water levels and the depths indicated by him in Tables 1 and 2 of his affidavit were not consistent with the depth of flow being higher at 8000 cusecs compared to the flow of 4000 cusecs. In this context, the changes indicated in Table (1) and (2) of the affidavit, Mr. Padhi confirmed that flow was closer to Odisha than Andhra Pradesh. On further cross-examination, he stated that the flood banks, though were at an elevation higher than the bank of the river, had not been provided in the entire stretch of State common boundary and would not be able to afford protection even when the flow was more than 52000 cusecs.

6.3.20 Referring to Tables 1 and 2 at pages 5, 6 and 7 of the affidavit of Mr. Padhi, when Mr. Vaidyanathan, learned counsel asked him in cross-examination as to whether he would like to make any corrections on the chainages referred to therein, Mr. Padhi clarified that the joint survey works by both Andhra Pradesh Engineers and Odisha Engineers were done from the chainage -3 km upto +2 km, i.e. proposed Neradi barrage site which becomes the joint survey of 15 km upstream of Neradi barrage and 10 km downstream of Neradi barrage and that the data shown at other cross sections i.e. from chainage +2 km to downstream of +22 km had been surveyed by Odisha engineers.

6.3.21 Inviting the attention of the witness to cropping pattern and the crop water requirement mentioned in para 5 and at page 17 respectively of his affidavit, the learned counsel stated that witness's statement in para 5 was not consistent with the information contained in the statement at page 17 of his affidavit or with the information contained in the DPR of Lower Vansadhara Irrigation Project. Mr. Padhi after verifying the details stated that the total quantum of crop water requirement as well as domestic and livestock needs shown earlier was same as 5.49 TMC. Referring to the result of model study carried by CWPRS, Pune in July, 2007 and the interim order passed by the Hon'ble Tribunal, learned counsel questioned the witness whether it was his evidence that the entire flow of the river would still go through the side weir. Mr. Padhi replied that from the field condition and topography, location of proposed side weir was such that there was apprehension that the entire flow would be diverted through the side weir. He further stated that there were no records available to show that for the

purpose of meeting the water requirement of 5.49 TMC, the discharge of about 8000 cusecs was required in the river but, basing on the cropping pattern and other needs, a calculation had been made and it was mentioned that 5.49 TMC was the total requirement of the left bank area of Odisha. Mr. Padhi was cross-examined in respect of sedimentation rate also. He agreed to a suggestion by the learned counsel that the rate of sedimentation in Vansadhara river is about the lowest compared to the rate mentioned in Table 2.13 of Ex.No.OW-2/17.

6.3.22 Mr. Padhi later clarified his answers in regard to the Pani Panchayats and about the procedure of handing over the lift points to the beneficiaries and compilation of documents in support of his statement was produced and exhibited as Ex.No.OW-2/20. He further clarified that as per the Pani Panchayat Act of Odisha, the notifications were issued for larger command area for minor irrigation, medium and major irrigation, and for lift schemes instead of notifications, only registration were done with the concerned Executive Engineer; therefore, no notifications had been issued for lift points. He further stated that he had not verified the correctness of the details shown in the Exhibit with the original records. On further cross examination he stated that he was not aware of the pond level of the proposed Neradi barrage and the left flood bank (LFB) was in existence only in some selected patches.

6.3.23 Mr. Padhi was further asked about the comments made on TR No.4459 of CWPRS at page 42 of Ex.OW-2/20. He stated that they were his own comments and further added that his finding to that

report is the model study which had been conducted adopting De Marchi equation, which was derived with certain assumptions like a defined channel, rectangular and prismatic channel and in the case at hand, the river Vansadhara was not a defined, rigid or rectangular channel and that therefore the model study could be adopted only for academic interest and not for practical purposes.

6.3.24 In conclusion, he was not in agreement with the suggestion of learned counsel that neither the side weir at Katragada nor the Neradi barrage proposed by Andhra Pradesh would in any manner cause any prejudice to the interests of the State of Odisha or its inhabitants.

6.4 Mr. Bishnu P. Das was cross-examined as the third witness (OW-3) on behalf of the State of Odisha on 19.08.2015, 20.8.2015 and 02.12.2015 by Mr. C.S. Vaidyanathan, learned Senior Counsel for the State of Andhra Pradesh. The summary of his affidavit as witness in examination-in-chief and summary of his cross-examination is reproduced hereinbelow:

AFFIDAVIT

6.4.1 In his affidavit Mr. Das submitted that Andhra Pradesh had attempted to interpret the agreement on the issue of length of the backwater stating that it starts from the tail of the Flood Protection Wall. Referring to the minutes of various meetings between the two State Governments, Mr. Das stated that there is no such evidence to interpret that backwater length of 3 km begins from the tail of the Flood protection Wall. Relying on Mathematical Model Studies submitted by CWC in August 1994, Mr. Das had observed that even

after the construction of Flood Protection Wall on the left bank extending up to 3 km upstream, the afflux was extending up to 8 km upstream of the barrage.

6.4.2 Referring to the Mathematical Model Studies conducted by the CWC in 2000, he stated "with the construction of 3 km long flood protection wall on the left bank of the barrage, the rise in water level was of the order of 46 cm and the backwater effect extended upto 9 km upstream of the barrage." Referring to the Physical Model Studies conducted by the CWPRS, Pune in 2005, Mr. Das stated that backwater length after construction of Neradi barrage would be of the order of 6 km upstream of barrage for the discharge equivalent to 16,990 cumecs. He also pointed out that the study was conducted by CWPRS, Pune without considering the 3.8 km long Flood Protection Wall.

6.4.3 Referring to various meetings between the two States, Mr. Das pointed out that Andhra Pradesh should draw water from the Neradi barrage only during Kharif season. However, the DPR of Vansadhara Project (Phase-II of Stage-II) filed by Andhra Pradesh shows that it had planned for irrigation beyond Kharif season.

6.4.4 According to him, perennial sugarcane crop was proposed in 20,000acres which would require about 8 TMC of water throughout the year. Besides this, there were other non-kharif crops over 18640 acres under the command area. On this reason he emphasised that Andhra Pradesh planned to build Neradi barrage with higher pondage involving large backwater stretch.

6.4.5 Per para 8 of affidavit, Mr. Das had stated that Side Weir at Katragada was not a temporary project as stated by Andhra Pradesh and according to him, the project would function even after the construction of Neradi barrage. He stated that as against the need of only 8 TMC of water by Andhra Pradesh, the gross storage of 16.55 TMC of Hiramandalam Reservoir appeared disproportionately high.

6.4.6 In his affidavit, he referred to the value of 'n' (Manning's rugosity co-efficient) adopted by CWC in its Model Studies, stating the same low as compared to the agreed value of 'n' between the two States. The Mathematical Model Studies by CWC had been calibrated for flood events of 1988 and 1991 which were considerably lower than the agreed design discharge of 6 lakh cusecs. He suggested for the reassessment of 'n' value and also taking cross sections of the river at closer intervals for Model studies. He claimed that drainage of overland agricultural lands in Odisha would suffer from chronic water logging due to the backwater effect upto 9 km. He believes that the livelihood of one lakh people upto Gunupur would be affected adversely.

CROSS-EXAMINATION

6.4.7 Commencing the cross-examination, learned Senior Counsel for the State of Andhra Pradesh suggested that the Rabi crop proposed was from out of waters which were drawn during the Kharif season and stored but supplied for irrigation thereafter. The witness stated that the Andhra Pradesh Neradi project proposal suggests drawal during the monsoon through a right bank channel and stored in reservoirs for subsequent utilization in the Rabi season which, he opined, was a

violation of the agreed conditions of water utilization only for the first crop. To a query by the counsel regarding proposed pondage at the Neradi barrage, the witness replied that he would have to examine the relevant report.

6.4.8 On further queries about the floods in 1980, the witness stated that he had some familiarity with the areas which were flooded in 1980 and could recollect the areas that were submerged to a large extent in the Odisha territory and that the discharge that was estimated to be the highest flood was of the order of 6 lakh cusecs. Learned counsel drew the attention of the witness to the Hydrograph annexed to the report of the CWC (Vol.3K) and asked the witness about the duration of the flood flow of 6 lakh cusecs. The witness replied that the flood lasted from 0 hours of 17th September to 0 hrs of 19th September and 6 lakh cusecs flood was the peak flood which showed a spike shape natural to any flood hydrograph corresponding to an intense storm event.

6.4.9 To a suggestion by the counsel that the flood started rapidly rising from about 2 lakh cusecs at 9 pm on 17th September to about 6 lakh cusecs around the midnight between 17th and 18th September, 1980, lasting about two hours but thereafter, came down rapidly to around 2 lakh cusecs by 6 am on 18th September, 1980, the witness replied that he would scrutinize the hydrograph minutely because the scale shown in the copy that he had was small and Xerox copy was not very clear. He further added that the areas between Gunupur and Neradi were submerged for two days or even more; areas upstream of Gunupur for another 20 km approximately got submerged and that the

Observed Maximum Flood Level (OMFL) could not be recorded exactly as the gauges installed for observation of flood level event upto Kashinagar which was the most downstream observation station in Odisha, were damaged by the high flood. He further opined that the nature of the terrain in the areas between Gunupur and Neradi were flat close to the river bank, did rise towards country side and they were basically arable lands supporting the livelihood of the people on the bank of the river, who are tribals predominantly.

6.4.10 To a query of the learned counsel, Mr. Das replied that during September 1980 flood event, he was a Superintending Engineer at Upper Indravati Project and had no occasion to directly advise or interact with the Chief Engineer in charge of flood or the then Engineer in Chief for protection scheme for the State of Odisha. When the counsel showed Mr. Das Ex.OW-2/14 and referred to the gaps between the embankments and protection walls, the witness opined that on the stretch beyond about 4 km upstream until the existing embankment which was above 8 km upstream to be flood prone and liable for submersion even to an extent of 2 m stretching about half to one km upto the railway line as the contour map revealed and that the anticipated flood level in this stretch was likely to be as high as 81 m as observed in the Mathematical Model Study of CWPRS in June, 2015. Mr. Das deposed that it could be seen that the 80 m contour was at a large distance from the river edge on the left bank and the strip in between was largely arable land and also fairly flat. He added that even further upstream the left bank contours and the right bank contours on the over bank showed a flat trend. He also stated that the 81 m

contour would be beyond the existing embankments. Besides, he brought out that the level would progressively rise almost parallel to the river bed slope consequent to a high flood of the order of 5 to 6 lakh cusecs and would be submerged impacting agricultural productivity and the livelihood of the tribal population on the river banks.

6.4.11 Relying upon Figure V and VI at page 12 of Ex.OW-3/1, Report of the CWPRS, Mr. Das, to a query, submitted that the protection wall as proposed on the left bank upto 3.8 km would provide protection to its left in the Odisha territory but, the back water exhibited a sudden rise of almost 2 m at the end of the protection wall which would cause additional submersion for another 5 to 6 km upstream and that would lead to additional submergence on the left banks lands as well as a consequent over bank submergence of the right bank of the river. To a suggestion by the counsel that only case No.7 in Table II (CWPRS Report, Ex.OW-3/1) would be relevant in the context of the proposed Neradi Barrage, Mr. Das replied that he would not agree to the observation of the CWPRS because of the possibility of the increase and decrease of 'n' value over a meandering and a flooding river, an invariant 'n' value over the bed and the over bank is not rational; he averred in his affidavit that 'n' value upto 0.1 has been estimated by eminent authors of hydraulics and hydrology such as V.T. Chow for highly vegetated river bank during floods and that this was precisely the situation of over bank flooding of a large order in the Vansadhara river once the flood exceeded 2 lakh cusecs.

6.4.12 To a further query, Mr. Das replied that he had studied the submergence extent for high floods upstream of Neradi barrage on the topographic map and only a detailed examination of the contour would reveal the additional submergence anticipated due to proposed Neradi barrage and that he had seen the contour map and given his deposition in regard to the adverse effect on Odisha due to additional flooding caused by the back water effect.

6.4.13 On further being cross-examined on his visit to various barrages in operation in different river basins, the witness replied that he had seen the hydraulic response of the barrage on the flood pattern during the pre-barrage and the post barrage conditions; each barrage normally caused an afflux due to imposition of constriction which extends backwards and causes the backwater rise; and the design provision was to reduce afflux to the minimum at the barrage and further upstream with adequate ventage etc. He added that in the context of Neradi barrage, it had been agreed as early as 1992 and even earlier to limit the backwater stretch upto 3 km only whereas the barrage as planned would lead to the backwater extending to 9 to 10 km.

6.4.14 Mr. Das explained the difference between effect of back water caused by a dam or reservoir as compared to a barrage that the backwater rise in reservoir which was a large body of water would be significantly lower in a corresponding situation of the barrage because the waterway available for conveying the high floods was extremely large. In contrast, he further added, the flood flow upstream of the barrage was within relatively narrow range and hence the afflux in a

barrage was higher than reservoir with similar hydrological parameters. To a further query regarding operation of gates during flood, he replied that the operation pattern of barrage was to open the gates to surplus the flood at as low a level possible. However, from the considerations of conservation during a drought spell the operation could be oriented to maintain a higher level for pushing optimal dose to the off taking channels. While suggesting that the bank full flow was less than 50000 cusecs at Neradi and if that was so, learned counsel asked the witness to envisage a situation where all the gates would not be open when the flood was of the order of 2 lakh cusecs or above. Mr. Das replied that this was a hypothetical question but every barrage will have an operating principle (Rule curve) for desirable operation to manage floods.

6.4.15 Learned counsel drew the attention of the witness to page 3 and para 4 at page 4 of his affidavit. Mr. Das wanted to examine the records of the State and report of the CWC of 2000 to answer the questions put to him about the authenticity of the minutes of the meeting held on 22.01.2008 etc. and back water. He further averred that the statement made in last sentence of para at page 4 of his affidavit was based on actual observation of aggradation upstream of Mundali weir on Mahanadi and also upstream of the barrage on Mahanadi and Birupa. On further cross examination, Mr. Das stated that he was aware of the provision of scouring sluices in the proposed Neradi barrage but, the flow during high flood which was normally concentrated across the entire width of the river cannot be flushed out totally through scouring sluices. He also stated that this had been the

experience of barrages under operation in India and shoals have occurred upstream in the barrage pond which lead to reduction of the discharging capacity of the sluices in the barrage as well as causing an additional back water rise that occurs following construction and operation of the barrage and that this aspect incidentally cannot be adequately predicted at either the analytical model or physical model studies.

6.4.16 When questioned why had he calculated the discharge based on stage discharge curve when the discharge data at Gunupur was provided by CWC, Mr. Das replied that the discharge data observed by CWC at Gunupur would cover specific discharge at specific stage and in order to obtain comprehensive information of discharge at all stages, a stage discharge curve was normally prepared based on observed information. He further answered that the estimate of abstraction of water through the proposed side weir was based on the table No.10 at page 34 of the CWPRS study of the Technical Report No.4459 of July, 2007.

6.4.17 With regard to a query whether the witness was aware that the Hon'ble Tribunal had passed an interim order to the effect that the drawals of water do not exceed 8 TMC and entrusted the responsibility to a committee to be constituted for supervising the functioning of the side weir, the witness further averred that he would have to examine the interim order of the Hon'ble Tribunal. He added that the estimate of 8 TMC had not been clarified by Andhra Pradesh and its relationship to the crop water needed to be served by the side weir.

6.4.18 He wanted to examine the submission of Prof. Yoganarasimhan to answer the questions regarding the discharge through the side weir estimated by him and also the rise in water level in the river due to the back water effect caused by the barrage and the protection wall.

6.4.19 Mr. Das denied the suggestion of the learned counsel that the value of 'n', that is rugosity coefficient, would be unique for a given observed maximum flood level, for the reason that the rugosity coefficient is not uniform across the width of the waterway and there is a significant increase on the over bank from the river because of obstructions, vegetation growth and even houses on the over bank. He added that the value of 'n' would keep changing from a cross section to a cross section depending on the boundary roughness and therefore, deriving 'n' at one cross section would not lead to a comprehensive assessment in a long alluvial river.

6.4.20 The witness was questioned about the study conducted by him to make the statement in para 10 of his affidavit that the backwater would extend upto 9 km of the proposed Neradi barrage. He answered that he took support from table 5.6 of Open Channel Hydraulics by Prof. V.T. Chow and relying upon the same, he had explained in his affidavit at page 10 in para 9 that the published authoritative literature on boundary roughness of rivers by Prof. V.T. Chow shows that the rugosity coefficient can be as high as 0.1 for forest growth on the over bank which incidentally was almost 2 km on both banks of river Vansadhara for the 1980 flood event of which the river

width was only 300 m. He stated that this extremely high 'n' value of the over bank caused/can cause high rise of the back water.

6.4.21 In the end of the cross-examination, learned counsel asked the witness to indicate what are the records of the Government of Odisha from which he had derived the information for the averments made in para 10 of the affidavit. Mr. Das stated that the most important records of the Government of Odisha, which were referred to by him, were the minutes of the inter-State meetings/discussions held by the Hon'ble Chief Ministers and the officials of both the States dating back from 1955 to date; the project reports prepared by the Government of Andhra Pradesh in respect of Gotta Reservoir Scheme, Gotta Barrage Scheme, proposed Neradi Barrage Scheme and the proposed side weir scheme made available to the Government of Odisha from the Government of Andhra Pradesh, which are on record, and the technical reports on flood and on utilization of Vansadhara water by Odisha like the spiral study were also referred to by him.

6.5 Mr. G.N. Yoganarasimhan was cross-examined as Odisha Witness No.4 (OW-4) by Mr. Vaidyanathan, learned Senior Counsel on behalf of State of Andhra Pradesh on 2nd and 3rd February, 2016. His affidavit as witness in examination-in-chief and cross-examination is summarized as below:

AFFIDAVIT

6.5.1 Prof. G.N. Yoganarasimhan has submitted his opinion with regard to Neradi barrage as well as the side weir at Katragada.

NERADI BARRAGE

6.5.2 He has submitted that the State of Odisha and Andhra Pradesh agreed to the construction of Neradi barrage subject to the following conditions:

i. The submergence will be limited to 106 acres

ii. The backwater effect will not go beyond 3 km upstream of the barrage

iii. The Manning's `n' value to be adopted in backwater computation should be 0.03 in the river bed and 0.04 for the flanks.

6.5.3 Prof. Yoganarasimhan has conducted backwater studies using Mathematical Model HEC-RAS for 5 scenarios which are as follows:

(i) No Barrage

(ii) with barrage as proposed

(iii) with barrage and Flood Protection Wall upto 3 km

(iv) with barrage and Flood Protection Wall upto 4 km

(v) with barrage, Flood Protection Wall upto 4 km and ultimate sediment.

6.5.4 Through his studies, he has shown that the backwater effect due to the construction of Neradi barrage goes upto 6 km upstream of the barrage. The backwater extends upto 8 km if Flood Protection Wall of 3 to 4 km is constructed and `n' value of 0.03 in the river bed and 0.04 on the flanks is considered.

6.5.5 He has stated that results are only approximate as the programme has indicated that the cross sections are incomplete and also not sufficient in number. In his view more cross sections located

closer need to be taken and also the existing flood embankments need to be marked in plan and cross sections taken in the beginning and end of these embankments. In the light of his studies, he has concluded that the State of Andhra Pradesh has failed to design the Neradi barrage within the agreed parameters.

SIDE WEIR

6.5.6 Prof. Yoganarasimhan has prepared a study by considering the following points:

(1) Is this project technically feasible?

(2) Is side weir a temporary project?

(3) Is inter-state river Vansadhara prone to sedimentation? If so, will there be an aggradation of the river bed leading to geo-morphological changes?

6.5.7 Prof. Yoganarasimhan has stated that side weir after the construction of Neradi barrage would continue to function under submerged conditions drawing more water than in the pre Neradi barrage condition and it would continue functioning irrespective of submergence. Referring to the planned diversion of 8 TMC through the side weir as against the live capacity of 17.55 TMC of Hiramandalam reservoir, he has called for the resolution of this issue. He has also stated that the Morphological changes in the river are long term in nature. He has submitted that the Hydraulic parameters of the river will definitely be prone to modification after construction of the side weir because the flow with reduced velocity or energy would result in higher deposition of sediments downstream of the side weir. Such

modification would induce bed level changes at Katragada side weir to the disadvantage of Odisha.

6.5.8 He has also stated that inter-State river Vansadhara is highly prone to sedimentation. Referring to the annual sediment inflow at the CWC site at Kashinagar, he has concluded that there is an increasing trend of sediment inflow.

6.5.9 He has opined that the side weir at Katragada is not technically feasible as it will not meet the reliability requirements of irrigation projects (75% success rate). He has also stated that side weir will fail to meet the economical and environmental yardstick. Prof. Yoganrasimhan has also commented on number of aspects of Physical Model Studies carried out by CWPRS, Pune. These comments have already been raised by Government of Odisha in its earlier submissions to the Tribunal. Prof. Yoganarasimhan has concluded that the proposal of the side weir is not feasible in terms of technical, economics and environmental considerations.

CROSS-EXAMINATION

6.5.10 At the beginning of cross-examination, learned Senior Counsel for the State of Andhra Pradesh tried to understand whether the witness was stating from his firsthand experience or from records. Referring to the backwater study of Neradi Barrage (Annexure-B of the affidavit of OW-4), particularly page 23, Tables 3 and 4, when the learned counsel questioned about the correctness of the findings reached by the Witness in respect of case No.2 mentioned therein i.e. where there was a barrage as proposed, without any flood protection

wall, there was no rise in water level at 0 km to 4 km from the barrage and there would be no back water effect as a result of the barrage at Neradi, the witness deposed that it was not correct to say that there was no back water effect but his finding was the output of the programme (HEC–RAS) which had been used.

6.5.11 Mr.Yoganarasimhan agreed to the suggestion of learned counsel that he had considered in his analysis 6 lakh cusecs floods at all points from 0 point at Neradi upto 15 km and also that he had not taken into account what was the flow in the tributaries which join the main river Vansadhara between Gunupur and Neradi and at which points they join the river for the purpose of analyzing the back water effect. He further agreed that he had not factored in a crucial point that in the proposed barrage, the crest level was only slightly higher than the bed level. He explained it by saying that he had imposed a boundary condition of 45 cm afflux (as calculated in the project report), which he believed would take care of the objection raised. The witness did not agree to a suggestion that sediments would get washed off as all the gates during high flood condition would remain open because of the raised crest. To a query by the learned counsel that there were six under sluice gates and operation of these undersluice gates would flush off the sediments, the witness responded that the sediments would be washed off only in front of under sluice gates.

6.5.12 Thereafter, learned counsel queried the witness on the extent of sedimentation the proposed barrage would cause and whether the calculations furnished by him were correct. Agreeing to Mr. Vaidyanathan's suggestion that Brune's Curve was normally applied in

the case of reservoirs and not in the case of barrages where the storage was low and the crest level was not high, the witness added that it could be used as an indicator. Learned counsel also found fault with the trap efficiency data furnished by the witness. The witness further deposed that in case of a barrage, there would be no demarcation between the dead storage and the live storage and for his computations he had taken Kashinagar data and not the flow at Neradi because it was a long term data maintained by CWC as compared to the data at upstream which was of shorter duration. He further stated that he had restricted the analysis to only 13 years period from 2000-2001 to 2012-2013 because only that data was made available, and he used data based on the recent publications that were available, that the dominant discharge corresponded to a return period of 1.58 years and corresponding to that, the dominant discharge figure at Kashinagar worked out to be 1399 cumecs. Even while agreeing that he was not a sediment transport specialist, the witness denied the suggestion of learned counsel that the hydraulic parameters of river channels would not be prone to modification after construction of side weir as sediment gets deposited on the downstream of side weir when clean water was drawn out.

6.5.13 To a suggestion by the learned counsel that Vansadhara river was highly prone to sedimentation was incorrect as concluded in para 17 of witness's affidavit, he agreed that the river was not highly sediment prone as in the case of northern rivers. The learned counsel brought out from the witness that the maximum discharge passing through the proposed side weir was around 1% of the maximum flood

discharge (6.0 lakh cusecs) in the river and as such apprehension about morphological changes were highly exaggerated. The witness did not agree to this explanation as the dominant discharge in the river was only 1100 cumecs approximately and this was the discharge which determined the morphological changes in the river.

6.5.14 While drawing his attention to figures 1, 2 and 3 at pages 67, 68 and 69 of his affidavit, the witness was asked whether those figures took into account the fact that the length of the side weir was 300 m and the channel's width was 165 m. To this, Mr. Yoganarasimhan replied that those figures are from flume studies in the laboratory and if they were considered as scale models, the flow configuration indicated is correct and that, irrespective of river channel width of 165 m which was not correct, holds good in this case. In this context, he referred to a Master's Degree thesis by Mr. Kiran Mangarulkar – Experimental and Numerical Study of the Characteristics of Side Weir Flows, a thesis in the Department of Building and Environmental Engineering, Concordia University, Montreal, Quebec, Canada, November, 2010.

6.5.15 The witness did not agree with the suggestion of the Senior Counsel that the flow pattern indicated by the witness in figure 3 at page 69 of the affidavit would cause a scour hole and the lower bed would attract the low flows towards the left bank rather than repelling the flow away from the left bank because the velocity in the recirculation portion was very low. Prof. Yoganarasimhan stated that the recirculation pattern had been seen very clearly in this particular case in the model studies when maximum discharge was run at CWPRS. He admitted that no sedimentation was present when the model

studies were run at CWPRS and in the model that he had referred. He further deposed that his conclusions about sedimentation were based on the existing condition on the field at the side weir site and the figures given in the thesis mentioned above and that the river was actually shifting at that point to the right. The witness also admitted that the flume study was concerned with a rectangular side weir in a rectangular open channel and that in the flume the bed need not be horizontal but it may be to a scale.

6.5.16 The witness agreed to the suggestion by the learned counsel that there was no geometrical similarity of the position studied in the flume study and the actual site condition at the proposed site of Katragada side weir. Mr. Yoganarasimhan agreed to the suggestion of learned counsel that the backwater development in the case of a barrage was not akin to conventional backwater profile in the case of high dams. To a suggestion by learned counsel that the river in the reach was in equilibrium and there was no trend of the three parameters namely, discharge, stage or sediment load increasing, the witness did not agree because both gauge and sediment load are showing an increasing trend.

6.5.17 In response to a query raised by the learned counsel, the witness clarified that the modified average sediment was equal to 3499540.769 metric tonnes and the sediment trapped was 209972.45 metric tonnes and the volume of these sediments was equal to 93737.70 multiplied by 1.3 with a void ratio of 0.3 was equal to 121859.01 cubic metres; this corresponded to a rise of 0.0432 metres

per year and that, therefore, it took about 20 to 22 years for the sediment made up as against 10 years mentioned by him earlier.

6.5.18 Proceeding further, learned counsel asked the witness whether he would agree that the statement given at page 82 of his affidavit regarding the average annual flow (132.9 TMC) and the 75% dependable flow (89.32 TMC) was much lower than the assessment made in Ex.OW-4/5, i.e. the Annual Report for 2013-14 published by the Department of Water Resources, Government of Odisha. The witness replied that the figures given by him were based on a CWC data at the gauge site, Kashinagar from 1971-72 to 2012-13 and he had no comment to make on the figures given in Ex.OW-4/5.

6.5.19 Citing the Awards of the Cauvery Water Disputes Tribunal (1.3% of mean annual discharge) and Krishna Water Disputes Tribunal (0.6% of mean annual discharge) in the context of water allocation reserved for environment protection, learned counsel pointed out that the proposal mooted by the witness at page 82 of his affidavit that 15% of the mean annual discharge of the River Vansadhara for the environmental flows was highly excessive and unacceptable. The witness disagreed with the aforesaid suggestion as the two basins mentioned above were highly developed much before the concept of environmental flow developed. Pointing out to the data furnished at page 89 of the affidavit, learned counsel had further asked him as to whether all the remaining water out of the share of Odisha goes into the sea to which the witness replied that only the water remaining after the abstraction of it by Andhra Pradesh would join the sea. To a suggestion by the learned counsel that the study carried out by the

witness was unreliable, the witness while disagreeing pointed out that the study was reliable and there was need to correct the cross sections or use interpolation and other manipulations to get the results.

6.5.20 The witness did not agree to the suggestion of the Senior Counsel that the conclusion made in para 9 of the affidavit that Andhra Pradesh had failed to design the proposed Neradi Barrage within the agreed parameters was incorrect. To another query, the witness stated that he had no opportunity to verify the flood magnitudes of each year and the figure of 6 lakh cusecs of flood was only an estimated figure. To a query, the witness answered that his statement that the side weir was not technically feasible was correct because the project was based on the divertible flows based on De Marchi equation which is not applicable and also the divertible flows given by CWPRS only corresponded to the crest level of the side weir 0.7 m above the river bed level and was also based on De Marchi equation. He further added that the side weir was not a temporary structure and it could also serve as head regulator once Neradi barrage came into operation.

6.5.21 Learned counsel concluded his cross examination with an emphatic suggestion that the statement of the witness in para 9 at page 63 of his affidavit that for unusually high floods, river course might change breaching the flood flow canal embankment was incorrect because protection works and the head regulator are designed for the highest flood level and that the gates of the head regulator would be closed to prevent the water from entering the link canal during unusually high floods, the witness replied that the head regulator provided for the flood flow canal was open type and during very high

floods it was not possible to control with the type of arrangement that was proposed.

6.6 Mr. V.V.S. Ramamurty was cross-examined as Andhra Pradesh Witness No.1 (APW-1) by Mr. Mohan V. Katarki, counsel, and in presence of Mr. Anil B. Divan, Senior Counsel on behalf of the State of Odisha, on 19th and 20th July, 2016**.** His Affidavit as witness in examination-in-chief and cross-examination is summarized below:

AFFIDAVIT

6.6.1 Mr. V.V.S. Ramamurty in his affidavit submitted as follows:

That the yield of the Vamsadhara River at Gotta Reservoir was estimated as 115 TMC in the meeting held on 30.09.1962. The total requirement of water of Andhra Pradesh was assessed as 54.5 (47.4+7) TMC. In addition to the irrigation uses as of 1961, it was agreed that the State of Andhra Pradesh will extend irrigation to about 2.56 lakh acres. The State of Odisha had agreed for the barrage at Neradi and that there would be small pondage at Neradi of an extent of 0.6 TMC within the banks of the river. The Neradi Barrage is a mutually beneficial irrigation project to the States of Andhra Pradesh and Odisha. It was agreed that execution of the Neradi project at Neradi would entail acquisition of 106 acres (exclusive of river bed) of land in Odisha territory. A sluice may be provided on the left flood bank at a place to be indicated by Odisha for any future irrigation in their territory.

6.6.2 It was agreed that the Neradi barrage should be redesigned for a peak flood of 6 lakh cusecs during the inter-State meeting held on

9.2.1985. In this meeting it was further pointed out that for such redesigning, additional land might be required for flood bunds and catch drains on Odisha side. But the State of Odisha insisted that acquisition of land on its side (excluding the riverbed) should be limited to 106 acres. The Government of Andhra Pradesh has proposed a protection wall of 3.8 km and a catch drain on Odisha side. It was agreed by Odisha that the afflux upstream of the barrage as computed by the Engineers of Andhra Pradesh beyond 3 km of the said proposed 3.8 km long protection wall would be within permissible limits in the meeting on 8.4.1988. The back water effect would not travel beyond 6 km.

6.6.3 Both the States had agreed for location of the barrage and quantity of drawal of water through the barrage. The utilisation of waters by the State of Andhra Pradesh through Neradi barrage will be within its share.

6.6.4 The project is beneficial to the farmers and inhabitants of both the States of Andhra Pradesh and Odisha and will not have adverse or prejudicial impact on them.

ADDITIONAL AFFIDAVIT

6.6.5 In a meeting held on 08.03.1991 and again in the subsequent meeting held on 22.11.1991, Andhra Pradesh offered either to extend the embankment up to 10.5 km in the upstream or to construct a 3.8 km long protection wall. The State of Odisha stated that the proposal for the construction of masonry wall 3.8 km long was acceptable.

6.6.6 In his affidavit Mr. Ramamurty stated that the back water study of Neradi Barrage with protection wall in position had been undertaken by the CWC and also by Prof. Yoganarasimhan, the witness of Odisha. According to him, the observed maximum flood levels in pre-barrage condition of the cross sections upstream of the proposed Neradi Barrage and the levels attained at these cross sections with barrage and protection wall in position as per the calculations of the CWC and also as per calculations of Prof. Yoganarasimhan and the corresponding rise in water levels (afflux) over the observed maximum flood levels in pre-barrage condition are given in Table in Para 3 (page 2) of the Additional Affidavit. The rise in water levels (afflux) arrived by CWC were taken as they were higher than those worked out by Prof. Yoganarasimhan except at cross section 1.0 where protection wall was anyway being provided. The levels worked out by CWC were therefore considered as to be on a conservative side.

6.6.7 He stated that the flood flow of the order of 6 lakh cusecs in the river Vamsadhara was a very rare occurrence and that even without a barrage or a diversion structure, the areas abutting the river on both the banks would get flooded during such high flows. The natural submergence in Odisha territory due to 6.0 lakh cusecs flood in the pre-barrage condition upstream of the proposed Neradi barrage was 1300 acres.

6.6.8 He further stated that in the post-barrage condition with protection wall in position as opted by the State of Odisha, the submergence in Odisha territory both on the left side and right side due to 6 lakh cusecs flood beyond the observed maximum flood line was

worked out as 18 acres and that due to construction of protection wall, the area of 360 acres behind the protection wall up to the observed maximum flood level which would have otherwise got submerged naturally would be permanently protected.

6.6.9 He also stated that the area that would get submerged in Odisha territory due to 6 lakh cusecs flood would be reduced from 1300 acres to 958 (1300+18-360) acres after construction of Neradi Barrage and the protection wall and that after execution of Neradi barrage with protection wall to a length of 3.8 km would reduce the total area flooded in the exceptional event of flood flows of the magnitude of 6 lakh cusecs for a few hours to the extent of 342 acres.

CROSS-EXAMINATION

6.6.10 Commencing the cross-examination, learned counsel for the State of Odisha queried whether he had worked in the Planning and Design wing of the Department of Irrigation in any capacity during his career. Mr. Ramamurty replied that there was no separate such wing in the Department of Irrigation and that he worked in the inter-State wing dealing with the agreements and awards with other States so as to see that those are adhered to in the project reports. He stated that he had not directly dealt with the designs and that with regard to planning, a part of that would be covered in the Inter-State wing. While showing the verification clause in his affidavits, learned counsel suggested to him that his statement in the verification clause was misleading as he had not worked in the Vansadhara Basin and, therefore, he could not have gained field experience. The witness denied the suggestion stating

that he had worked in Balemella Dam Project, a joint project of the States of Odisha and Andhra Pradesh and also in Lower Sileru Project etc., both projects situated in Godavari Basin and adjacent to Vansadhara River Basin and had acquired field experience. With regard to a query by the learned counsel about his examination as a witness in Krishna Water Disputes Tribunal-II, the witness mentioned that the bio-data indicated only broad experience and as such there was no suppression of facts.

6.6.11 Learned counsel drew the attention of the witness to Annexure-D to the additional affidavit dated 24.11.2014 and particularly points F1 and F2 shown on the cross section of Vansadhara River between 6 km and 7 km on the map, and cross-examined him on the backwater formation. The witness stated that at these two points F1 and F2, the river width narrowed down forming a constriction and that where there was a natural constriction like the one at F1 and F2, the river regime adjusted itself to that phenomenon. He further added that whenever there was a new construction across the river, backwater would be there.

6.6.12 Learned counsel referred to the study of Prof. Yoganarasimhan and drew the attention of the witness to Table 3 and col.1 which was Case-1 scenario, which showed different water levels at different locations and suggested that water level at constriction point at 7 km (80.27 m) was lesser than water level at 6 km (80.30 m) and this reduction of water level for a short length was due to increase in velocity of flow. Mr. Ramamurty replied that Case-1 related to no barrage condition as already stated by Prof. Yoganarasimhan and that

he would agree that there would be very high velocity of flow and these rapids only were restricting the backwater from moving up with the construction of the Neradi barrage. He added that apart from the increase of velocity in the constriction region at a particular point in the heading up of water, there were certain other factors like the width, the slope etc. which would play a vital role for the increase in water level in the upstream region of constriction. To a further query, he replied that the rapids coming from upstream would not allow the backwater to flow further resulting in reduced levels of afflux.

6.6.13 The witness denied the suggestion of the learned counsel that his views in para 6 of the main affidavit as well as in additional affidavit on backwater effect were generalized statements based on toposheet studies, assumptions and presumptions and without conducting any investigation or studies. Mr. Ramamurty emphasized that he had visited the field a number of times and observed the topography and the orography of the region, the proposed project site and the surroundings and all the cross-sectional levels upstream of the barrage had been taken into consideration while coming to the conclusion depicted in para 6 of the main affidavit as well as in additional affidavit on backwater effect. He further denied the suggestion of the learned counsel that he did not possess sufficient expertise to conduct studies on backwater effect based on toposheets.

6.6.14 On further questioning, the witness stated that beyond 3 km from Neradi barrage and upto 15 km there were many major streams, in addition to Gadiakhala from left and Jagannathpur nalla and Shirjuli nalla on right, which join the river Vansadhara. The witness agreed to

the suggestion of the learned counsel that when the proposed wall is constructed in the upstream of Neradi barrage for 3 km, the flows from these two nallas which join Vansadhara river would get blocked, forming backwater in the upstream of those nallas and stated that it was because of this only a catch drain is proposed behind the protection wall to drain away the water to the downstream of the proposed Neradi Barrage. Further, he added that when he visited the site, he had seen the bunds already constructed upstream of the proposed Neradi Barrage on the left side and also on the downstream side; at the end of the downstream side bund of about 400 to 500 m long a regulator was also provided through which the water behind the protection wall could be drained. The witness appreciated the State of Odisha for taking steps in that regard.

6.6.15 Learned counsel questioned the witness whether he had conducted any study on the hydrology of Gadiakhala nalla and Jagnnathpur and Shirjuli nallas before forming an opinion that the drains proposed by Andhra Pradesh Government were sufficient to take care against the backwater formation. The witness replied that he had not conducted any study nor there was any need as the States of Odisha and Andhra Pradesh agreed for the design of the catch drain and that all these matters relating to protection wall, catch drain etc. would come up at an advanced stage of construction of the Neradi Barrage and any advice or suggestion of the State of Odisha would be taken care of.

6.6.16 To a query of the learned counsel as regards the backwater formation of the nallas upstream of 3 km and upto 15 km from Neradi

Barrage, the witness, taking cue from the studies conducted by Prof. Yoganarasimhan, CWC and also CWPRS, answered that for the nallas upstream of 6 km there would be no problem on account of construction of Neradi Barrage and the protection wall as the effect of backwater beyond 6 km upstream of Neradi Barrage would be within permissible limits; and that downstream of 6 km and upstream of 3 km, on the right side there are two streams by name Belligada and Verrigada and these would be suitably bunded to meet the 6 lakh cusecs flood effect.

6.6.17 When learned counsel stated that the above statement of the witness was misleading and incorrect, Mr. Ramamurty denied the suggestion by saying that as per the Inter-State meeting held on 8.4.1988, it was agreed that the afflux upstream of the proposed Neradi Barrage beyond 3 km of the end of the protection wall will be within permissible limits and, therefore, it was not correct to say that the two States agreed for backwater effect to be within 3 km upstream of the barrage. Further, he added that once protection wall was constructed on the left side, the question of effect of backwater upto 3 km does not arise at all as the protection wall will safeguard the villages Sara and Badigam and the surrounding areas behind the protection wall. He further added that as per the studies conducted by CWPRS even though the backwater travels beyond 6 km, the rise in water level beyond 6 km is well within the permissible limit of 1% of normal depth and as such there is no damage to State of Odisha on account of backwater.

6.6.18 Learned counsel drew the attention of the witness to the flood hydrograph prepared by CWC, at page 110 of Vol. K to the

Statement of the Case of Andhra Pradesh, which showed the backwater effect in river Vansadhara would stay for about six hours when the flood of 6 lakh cusecs impinged on the proposed Neradi Barrage to which Mr. Ramamurty replied that in his view the maximum flood might have been there only for a duration not exceeding two hours when the peak flood of more than 16,000 cumecs occurred sometime between 11 pm of 17th September to 01 am of 18th September, 1980.

6.6.19 The witness denied the suggestion of the learned counsel that the backwater and high stage in the nallas will be for a much longer period due to storage and narrow mouth of the nallas when the backwater of river Vansadhara stays for six hours or even for two hours. He clarified that Vansadhara was practically a hill stream and was very steep and when once the flood started receding, the backwater in the nallas etc. recede immediately. He also denied the suggestion of the learned counsel that the backwater effect staying for six hours or even two hours as suggested by the witness would damage the farm lands, habitation and sources of drinking water besides creating water logging for next few days or a week. As per CWC guidelines, he added, the farm lands would be affected if the submersion is for more than 15 days and therefore there need be no apprehension on this account.

The witness further stated that about 360 acres of land, which would have been submerged in pre-barrage condition, would be saved if three kilometre wall is constructed. Suggestion of the counsel of Odisha was held to be totally erroneous by the witness because according to him, three kilometre wall would not block the entry or

release of water from the two nallas to the main river Vansadhara. According to him, there would not be flood situation when the flood of about 6 lakh cusecs impinged on the proposed Neradi Barrage. The witness discarded the apprehension by clarifying that the area protected may come down to about 340 acres as 15 to 20 acres may be needed for providing a catch drain behind the protection wall. Regarding the two nallas referred to, he added, if necessary, protection bunds would be provided upto maximum flood level or would be drained through the catch drain depending upon the field situation or suggestion of the State of Odisha.

6.6.20 Learned counsel brought to his notice that in para 4.2 of the affidavit it has been mentioned that in addition to irrigation uses of 1961, it was agreed that Andhra Pradesh would extend the irrigation to about 2.56 lakh acres but suggested that there was no agreement as such. The witness agreed that there was no such agreement but it was his own interpretation. He further elaborated that it had been agreed that Andhra Pradesh would utilize about 47.4 TMC of water under the Vansadhara Irrigation Project (A.P.) which included Gotta reservoir and a barrage upstream. This was in addition to about 7 TMC of irrigation uses of 1961. Thus, it was expected that Andhra Pradesh would use about 57 TMC and Odisha would also use almost the same quantity out of the estimated yield of 115 TMC. Thus, by utilizing 47.4 TMC, Andhra Pradesh was expecting at that time to irrigate more than 2.5 lakh acres.

6.6.21 The learned counsel invited a reference of the witness to Vansadhara Project Report of November 2006 (p.75) and mentioned that as per the Understanding recorded on 4.9.1962, a cultivation of

perennial sugarcane crop was contrary to this Understanding. The witness did not agree to this suggestion and clarified that the Neradi Project contemplated in 1962 was a standalone project and that under this project, water would be diverted from barrage into the right canal and there was no storage reservoir, and only one crop was provided. He added that subsequently, after 1969, the scheme was changed and water from Neradi barrage through right canal was proposed to be dropped into Hiramandalam Reservoir and that under Hiramandalam Reservoir the sugarcane cultivation which was already existing through open head channels was proposed to be continued. He stated that even now, in the stretch between Neradi and Hiramandalam, only one crop would be there.

6.6.22 The learned counsel made a mention of Vol.3-C of Andhra Pradesh's Statement of Case (Vansadhara Stage-I Report of 1969, page 18) wherein it has been mentioned that out of the total command of 36,817 acres of Narayanpuram Anicut across Nagavali River, about 32,600 acres can be brought under irrigation of Hiramandalam right side canal and suggested that this irrigation of 32,600 acres was outside the Vansadhara basin. The witness clarified that as per the latest project report, this had been curtailed to 5,000 acres only and this area is within Vansadhara basin only.

6.6.23 While referring to Annexure-C to the witness's affidavit wherein the witness had given unutilized flows of Vansadhara basin, learned counsel questioned Mr. Ramamurty about using the surplus water by constructing lift irrigation scheme within its territory to use the surplus water going to sea. Mr. Ramamurty replied that lift

irrigation system is costly and not preferred as long as it is possible to irrigate the areas by gravity and that the present scheme of Vansadhara Irrigation Project of Andhra Pradesh contemplates irrigation by gravity.

6.6.24 The witness concluded his deposition by denying the suggestion of the learned counsel that the contents of his affidavits are not based on field experience or expertise in water resources engineering particularly open channel flow and that they are also full of contradictions and assumptions and self-serving interpretations and, therefore, not reliable.

6.7 Mr. Routhu Satyanarayana was cross-examined as Andhra Pradesh Witness No.2 (APW-2) by Mr. Mohan V. Katarki, counsel and in presence of Mr. Anil B. Divan, Senior Counsel on behalf of the State of Odisha, on 24th and 26th August, 2016**.** His affidavit as witness in examination-in-chief and cross-examination is summarized below:

AFFIDAVIT

6.7.1 The summary of the contents of his affidavit is provided below:

The Government of Odisha had agreed during inter-State Conference held at Bhubaneswar in July, 1961 for construction of the Neradi Barrage. The land acquisition on State of Odisha side was computed as 106 acres including the area for the banks, catch drain and an outfall sluice on downstream of the barrage. After unprecedented flood in the year 1980, Government of Andhra Pradesh, Government of Odisha and Central Water Commission had agreed for redesigning the

barrage for a flood discharge of 6,00,000 cusecs. But the Government of Odisha insisted on limiting the acquisition of land to 106 acres only on its side (excluding the river bed). To limit the land acquisition, the Government of Andhra Pradesh had proposed a protection wall of 3.8 km. Odisha had accepted these proposals in the meeting held on 8.4.1988. All other aspects like adequacy of catch drain, inspection path, foot bridge, out fall structure etc. were also agreed to.

6.7.2 Due to delay in the Neradi Barrage, Government of Andhra Pradesh proposed temporary side weir to utilize 8 TMC of water allocated to Andhra Pradesh. The sill level of the side weir is proposed at EL +70.40 m. which will be 0.90 m. above the river bed level. River waters can spill over the side weir, when the flood flow in the river exceeds 4,000 cusecs within its 50% share in the river waters. Side weir will not cause any hardship or prejudice to the State of Odisha.

6.7.3 The State of Odisha stated that it required about 8000 cusecs of flow in the monsoon period in the river downstream of Katragada to meet its irrigation and domestic needs on the left side of the river. The discharge of 8000 cusecs flow would be only for about 33 days in a year on an average. Thus the total requirement for 33 days with 8000 cusecs flow will be about 23 TMC. The claimed requirement of Odisha upstream of Katragada is 52 TMC, against total requirement of 57 TMC on entire Vansadhara basin as stated in its complaint. Thus the requirement of Odisha below Katragada cannot be more than 5 TMC.

6.7.4 It is alleged by the State of Odisha that by reason of the construction of the proposed side weir, scouring would take place on

the right side and silting would take place on the left side of the river. According to him, discharge withdrawn through the side weir is only small fraction of flood discharge and hence the flow pattern in the river will not be affected.

CROSS-EXAMINATION

6.7.5 During his cross-examination, the witness stated that he was involved in the designs of Neradi barrage and side weir and did not work in the field offices concerning the said projects. The learned counsel suggested that the backwater effect not extending beyond 3 km was to be calculated from the barrage and not from the tail of the protection wall as suggested by the witness (Reference to the Minutes of the meeting dated 8.4.1988). The witness denied the suggestion and stated that it was a matter of record including para 2.2 of the Minutes dated 8.4.1988. Referring to the DPR of the side weir of 2006 (Vol.3-I, Annexure-9 of the Statement of Case of A.P., p.61) wherein it was mentioned that the drinking water supply proposed under the project was only 0.722 TMC, the learned counsel suggested that the statement made in para 7 of witness's affidavit that large population in the area had to depend for drinking water was misleading. The witness denied the said suggestion and replied that the intention of the Government of Andhra Pradesh was alteast to utilize 8 TMC of water for the benefits of the ayacut, the ryots and the population suffering even for drinking water instead of unutilized water going to sea. He also denied the suggestion of the learned counsel that due to the proposed alignment of the side weir, the direction of the flow in the river would shift and would be attracted significantly towards the side weir. He further

explained that only a part of the flow in the Vansadhara River from 4000 cusecs and above would spill over into the pond of the side weir and that major quantity of the flow from 4000 cusecs and above would be kept flowing in the main river course.

6.7.6 To a query regarding the crest level and length of the side weir, the witness replied that the crest level of the side weir will be at a constant level of RL.+70.40 m and length of the side channel will be 300 m. The learned counsel invited a reference to DPR of Side Weir 2006 (p.85) and mentioned that the length of the side weir was considered as 118.3096 m but in a narrative portion it is stated that 300 m length is necessary in order to divert the flow to meet the requirement of Hiramandalam reservoir. The witness emphasized that the length of side channel will be 300 m. He explained that the estimation of flow through an open channel with non-uniform flow is complex and that it would be only a rough estimate. The hydraulic calculations had to be verified by model studies. This aspect had been clarified in a meeting dated 7.4.2005. The witness accepted the suggestion of the learned counsel that out of 23 TMC of flow in the Vansadhara River, the consumptive utilization of Odisha was only 6 TMC and the rest 17 TMC water would ultimately go down to Andhra Pradesh for its benefit.

6.7.7 The suggestion by the learned counsel that the water requirement in Odisha (paras 16 and 17 of the affidavit) were not based upon any personal technical study on the crop water requirement and analysis of the drawls was denied by the witness. He further stated that as per the project report of Odisha relating to Lower Vansadhara Project Stage-I, the total requirement of the State of Odisha for

irrigation, drinking water and livestock is estimated to be about 4 TMC. The learned counsel invited reference to para 7 (Affidavit) and mentioned that Andhra Pradesh proposes to utilize 8 TMC of water from the proposed side weir but the design parameters of the side weir particularly as clarified by him that it would be planned for the length of 300 m, and suggested that thereby Andhra Pradesh may draw 15 TMC to 40 TMC and therefore, the side weir as designed was an oversized weir. This suggestion was denied by the witness. He stated that the designed capacity of the flood flow canal is only 6400 cusecs. The withdrawals through the side weir can however be regulated by the 'Flow Supervisory and Monitoring Committee' as per the orders of the Hon'ble Tribunal.

6.7.8 Learned counsel further cross examined about the technical assessment on the impact of sedimentation and aggradation of the bed of the river near the proposed side weir. The witness replied that he had verified the DPR 2006 on side weir and found that no such assessment was made. He opined that there was no necessity of making such assessment as all the flows upto 4000 cusecs and the major quantity of flows above 4000 cusecs keep on going along the main river course carrying all the sediments. He further elaborated that aggradation and degradation is a natural phenomenon in the rivers and that these studies were normally carried out whenever they were required.

6.7.9 The witness denied the suggestion of the learned counsel that if the bed of the river had suffered aggradation at Kashinagar as shown in Ex.OW-2/6 (a graph showing comparison of bed level of cross

section at Kashinagar for different years), the crest height of 0.9 m of the side weir might gradually lose its height and close up in less than nine years forming sand cast etc. The learned counsel referred to DPR of side weir of 2006 (p.33) and cross-examined the witness about the design capacity of the regulator of side weir and the withdrawal capacity thereof and suggested that withdrawal capacity of side weir would be 8000 cusecs and not 6400 cusecs. The witness answered that the canal head regulators would normally be designed for higher capacities; the design capacity of the link canal from head regulator of the side weir was only 6400 cusecs and that the link canal carried the flows and joined the flood flow canal of Neradi Barrage with an ultimate capacity of 8000 cusecs. Denying the suggestion of the counsel that the flow pattern of the river would be significantly affected by diversion of water from the side weir, the witness stated that the Vansadhara River was only rain-fed and quite erratic; hence, a storage was essential in such a river basin. Although the witness did not agree to the technical proposition put forth by the counsel that once water was diverted through the side weir, the flows in the river to the extent of diversion would be reduced and the reduced flows in the river would have lesser velocity, he stated that there could be likelihood of small quantity of sediment deposit if any on the downstream side of the side weir and that could be removed periodically as per the orders of the Hon'ble Tribunal.

6.7.10 The witness also denied the suggestion of the counsel that without constructing Neradi barrage or side weir at Katragada, the planned 8 TMC of water from river Vansadhara could be pumped by

installing lift system in the region upstream of proposed barrage and downstream of Katragada or in any location downstream of Neradi barrage with a small head. He mentioned that as an Engineer it was his preference to go for a gravity flow wherever it was possible. He further stated that Neradi barrage site had been selected by the experts of both the States of Odisha and Andhra Pradesh after examining several sites both on upstream and downstream, and that the lift scheme was also examined and found uneconomical. He opined that once the State of Odisha agrees for construction of the proposed Neradi barrage and hands over the land, as agreed upon, the necessity of the side weir might not exist.

6.7.11 The learned counsel brought to the notice of the witness that the revised Detailed Project Report of Side Weir 2014 had not been mentioned in the affidavit, the witness replied that at the time of filing of affidavit, DPR 2014 was under preparation. The witness denied the suggestion of the learned counsel that Lower Vansadhara Project Stage-I did not quantify the total water requirement of the State of Odisha on the left bank of river (below Katragada). He also denied the suggestion that his statement that the total requirement of water was about 4 TMC was incorrect and he stated that the figure of about 4 TMC had been computed from the ayacut and also through the duty of the canal flows. The witness denied the suggestion of the learned counsel that the contents of his affidavits are not reliable.

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7

STUDIES CARRIED OUT

7.1 GENERAL

7.1.1 During the negotiation and discussion between the States of Andhra Pradesh and Odisha for the execution of the proposed Neradi barrage and Katragada side weir, a number of technical studies were taken up to assess the extent of back water, variation in the flow pattern in the river post project, any possible morphological changes and the efficacy of the proposed project. In a meeting held on 10.06.1992 between the Chief Ministers of Odisha and Andhra Pradesh, it was agreed in principle that Andhra Pradesh can go ahead with the construction of Neradi barrage subject to mathematical model studies on the protective measures proposed by Andhra Pradesh. Accordingly, Andhra Pradesh requested Central Water Commission (CWC) to carry out mathematical model studies for the proposed Neradi Barrage. These were carried out by the Central Water Commission for various conditions during 1994 to 2000 and the final report was submitted in April 2000. In a meeting held on 15.02.2001 under the chairmanship of Chief Minister of Odisha, officers of Government of Odisha pointed out that only mathematical model studies are not enough and that Physical Model Studies are also to be conducted, which will be more reliable. It was agreed that Central Water and Power Research Station (CWPRS), Pune may be associated with the conduct of physical model studies. The Physical Model Studies for Neradi Barrage were carried out by the

CWPRS, Pune in 2005. As per the decisions taken in various meetings taken by Secretary (WR) and Additional Secretary (WR), Government of India, during 2006 and 2007, the work of carrying out the physical model studies for side weir at Katragada was given to CWPRS, Pune. The CWPRS submitted its report for Side Weir at Katragada in 2007. Yield study for the assessment of the water availability in the Vansadhara river basin was carried out by a team comprising of officers from Central Water Commission and co-basin States in 2007. The Hon'ble Tribunal visited CWPRS, Pune on 03.5.2013. During the power point presentation made by the Director, CWPRS, it was observed that since the physical model studies of Neradi barrage was carried out in year 2005, the Tribunal felt that fresh data should be provided to CWPRS for it to decide if changes are required in the model studies done so far and it directed accordingly. The CWPRS carried out the mathematical model studies for the proposed Neradi barrage with the fresh data in 2013 and submitted the report in August 2013.

7.1.2 During the visit of the Tribunal to CWPRS, Pune on 4th and 5th Dec., 2014, it was decided that CWPRS will carry out studies for back water for Neradi barrage with the protection wall. The CWPRS submitted its report in June 2015. During the above mentioned visit of the Tribunal, representatives of Odisha raised reservations with reference to the studies carried out by CWPRS. These were addressed by CWPRS in the Power Point Presentation made before the Tribunal as well as through their letter dated 15.12.2014. The report of the visit of the Tribunal to CWPRS, Pune is placed as Appendix-3 in Volume-III (Appendixes).

7.2 MATHEMATICAL MODEL STUDIES CONDUCTED BY CENTRAL WATER COMMISSION – MARCH, 1994

7.2.1 The Secretary, Ministry of Water Resources, Government of India called a meeting on 8.3.1991 to discuss and resolve inter-State issues on Vamsadhara Stage-II Project of Andhra Pradesh. In the context of the Odisha Government's suggestion for taking up model studies, it was observed that while flood moderation or backwater studies can be best studied by Mathematical model, physical model studies are generally required, if the river is either mobile or having unstable regime. It was accordingly agreed that a team of officers of Governments of Andhra Pradesh and Odisha and CWC would visit the site and submit a report about the necessity of taking up model studies and purpose thereof. Accordingly a team consisting of officers of CWC, Government of Andhra Pradesh and Government of Odisha inspected the site on 22.12.1991. In its observation the team noted that the river had a stable regime and therefore, there was no necessity for taking up the Physical Model Studies for studying the behaviour of the river to take appropriate decisions for necessary flood protection works in Odisha territory under the post barrage condition.

7.2.2 As regards the possibility of aggradation of the river bed in the backwater zone, it was felt that necessary studies could be carried out on mathematical models. These studies could be carried out before finalization of the flood protection works.

7.2.3 In the meeting held on 10.06.1992 between the Chief Ministers of Odisha and Andhra Pradesh, it was agreed that Andhra Pradesh can go ahead with the construction of Neradi Barrage subject

to mathematical model studies on the protective measures proposed by Andhra Pradesh. Accordingly, Government of Andhra Pradesh requested CWC to carry out Mathematical Model Studies for the proposed Neradi barrage on river Vansadhara.

7.2.4 This study was carried out by CWC as per Hydrodynamic and Morphological objectives communicated by Government of Andhra Pradesh. CWC concluded that (i) The river is morphologically stable (ii) The maximum bed aggradation is of the order of 35 cm and extends upto 6 km upstream of the barrage and (iii) with the construction of the flood protection wall, the afflux is experienced upto 8 km upstream of barrage.

7.2.5 As per the analysis of the sediment transport data, the river carries only fine sediment (wash load) of size less than 0.075 mm during the low flows. However, this wash load is expected to get lifted up from the bottom and washed down as suspension during the flood season when the gates are open. A discharge more than 600 cumecs for about 12 hours was considered sufficient to wash the load. The minimum flow of 600 cumecs is available for about 3 days in the monsoon period on an average. Therefore, there is hardly any chance of the pond getting cumulatively silted up. As such there is no adverse effect of the lean season deposition due to ponding. The final report of the study was made available to the Government of Andhra Pradesh in March, 1994.

7.3 SUPPLEMENTARY STUDY AND SENSITIVITY ANALYSIS BY CWC

7.3.1 In order to limit the net aggradation due to construction of the barrage to within 3 km upstream of the barrage, Government of Andhra Pradesh suggested to carry out "Supplementary study" by shifting the existing flood bank on right side of river Vansadhara slightly away from the present position and by training the river. The study was carried out and the required optimum widening of the river at the constricted cross-sections was worked out such that there is no additional afflux due to the constriction. The report was submitted to the Government of Andhra Pradesh in September, 1994.

7.3.2 However, there was a disagreement between the Government of Andhra Pradesh and Odisha over the calibrated 'n' values worked out in the model studies. This `n' value is used in the Manning's formula for calculating the discharge in the river. Government of Andhra Pradesh requested CWC to carry out 'Sensitivity Analysis' study by varying the value of `n` by +/-10%, +/-15% and +/-20%. Accordingly the study was carried out and report submitted to the Government of Andhra Pradesh in July 1995.

7.4 MATHEMATICAL MODEL STUDY CONDUCTED BY CWC – APRIL, 2000

In a joint meeting of officers of Andhra Pradesh and Odisha, held on 9.12.1995 it was decided to request CWC to carry out the study using a fresh set of cross-sections taken by a joint survey team

comprising of officers from the Government of Andhra Pradesh and Odisha. Project Administrator and S.E., Vansadhara Project Circle, forwarded the revised cross-sections to CWC and requested to carry out the Mathematical Model studies. The objectives of the study and its conclusion are as follows:

7.4.1 OBJECTIVES OF STUDY

A. HYDRODYNAMIC

To determine likely maximum water levels upstream of the proposed Neradi barrage for the Design Flood for the following bed conditions:-

(i) Rigid Bed

(ii) Movable bed before attaining regime

(iii) Movable bed after attaining regime

The above conditions were studied under the following ground situations:

a. No barrage

b. Barrage with guide bunds only

c. Barrage with 3 Km wall on the Left Bank in the u/s of the Barrage.

B. MORPHOLOGICAL

Extent of likely aggradation /degradation consequent to the construction of the Neradi barrage and its effect on the water levels due to the Design Floods.

7.4.2 CONCLUSIONS

(i) The study of Morphological characteristics of the river from Gunupur to Kashinagar indicates that the river is morphologically stable.

(ii) The maximum afflux due to the construction of Neradi Barrage is of the order of 36 cm and extends to a distance of about 6 km upstream. However, with the construction of the flood protection wall on the Left bank extending 3.0 km upstream of the barrage, the maximum afflux is 46 cm and extends upto 9.0 km upstream of the barrage.

7.5 JOINT STUDY CONDUCTED IN CWC TO ASSESS THE YIELD OF VANSADHARA RIVER

7.5.1 BACKGROUND

Secretary, Water Resources, Government of India held a meeting on 24th April 2006 with Secretaries, (WRD), Government of Odisha and Government of Andhra Pradesh. Odisha representative desired that the yield of the river should be reassessed by utilizing the yield series upto 2005 and stated that they were agreeable to share the water of Vansadhara river on 50:50 basis as agreed to in 1962. Andhra Pradesh had no reservation to this reassessment of yield and sharing the yield of the river on 50:50 basis. It was decided that CWC will re-assess the yield in the river using the yield series upto 2005 and representatives of both the States would be involved in yield studies by CWC.

A joint working group comprising of officers of CWC and Co-basin States of Andhra Pradesh and Odisha was constituted to carry out the yield studies.

7.5.2 CONCLUSION

The 75% dependable yield for Vansadhara basin at Gotta barrage has been worked out to be of the order of 105 TMC.

7.6 PHYSICAL MODEL STUDIES FOR THE PROPOSED NERADI BARRAGE CONDUCTED BY CWPRS (TECHNICAL REPORT NO. 4212) FEBRUARY-2005

7.6.1 BACKGROUND

During February 2001, Chief Minister Odisha chaired a meeting in which Government of Odisha officers pointed out that people of Gunupur and surrounding areas are very much apprehensive in view of devastating experience of 1980 floods. This being a sensitive issue, all design parameters need to be checked very carefully before taking any decision. It was further pointed out that only mathematical model studies are not enough. Physical model studies are to be conducted which will be more reliable. It was agreed that CWPRS, Pune may be associated with the conduct of Physical Model studies. Keeping this in view, the Government of Andhra Pradesh awarded this study to CWPRS, Pune in March, 2001.

7.6.2 OBJECTIVE

(a) The model studies carried out under the existing pre-barrage and post-barrage conditions for back water effect.

(b) Adequacy of protection measures on the upstream of the proposed barrage was also examined.

7.6.3 MODEL

A hydraulic scale model was constructed to a scale of H=200 and V = 40 and the studies were conducted with four discharge stages such as 1000, 2832, 5663 and 16990 m^3/sec (i.e. 2, 25, 200 years return period and observed maximum) to study the effect of the Neradi barrage on river Vansadhara.

Desk studies were also carried out using HEC-6 model.

7.6.4 CONCLUSIONS

(i) According to hydraulic scale model as well as HEC-6, back water length after construction of Neradi barrage would be of the order of 6 km upstream of barrage for a discharge equivalent to 16,990 m^3/sec.

(ii) For a discharge equivalent to 16,990 m^3/sec, increase in water level at cross section No. 2 (2 km upstream of the barrage) over the existing condition was 0.72 m. With HEC-6 results this was 0.68 m which is comparable with model results.

(ii) Rise in water level was of the order of 16 cm at 6 km upstream of the barrage. However, this diminished rapidly immediately after 6 km and was negligible at 7 km upstream of the barrage.

(iv) The maximum velocity was observed 6.17 m/s with barrage in position and accordingly the upstream protection measures i.e. concrete block and loose boulder were modified.

(v) Geo-fabric filter is proposed instead of granular due to its advantages.

7.7 PHYSICAL MODEL STUDIES CONDUCTED BY CWPRS FOR THE PROPOSED SIDE WEIR AT KATRAGADA (TECHNICAL REPORT NO. 4459) JULY-2007

7.7.1 BACKGROUND

As the construction of proposed Neradi barrage was getting delayed, the Government of Andhra Pradesh proposed to construct a Side Weir at Katragada to draw water for filling the Hiramandalam reservoir through flood flow canal. The total length of the proposed side weir was 300 m and crest level at R.L. 70.40 m. The side weir is designed for discharge capacity of 6400 cusecs and maximum discharge capacity of head regulator is of 8000 cusecs. In a meeting taken by the Secretary, Water Resources during the April 2006, Government of Odisha officers stated that the impact of the Side Weir channel can only be assessed by conducting Physical Model Studies by CWPRS.

Accordingly Andhra Pradesh asked CWPRS to conduct Physical model Studies on the Side Weir at Katragada.

7.7.2 OBJECTIVE

a. To examine flow pattern for flow discharges equivalent to 150, 200, 400 m^3/s in Vansadhara under existing condition.

b. To examine flow conditions for high discharge stages 8495 m^3/s and 16990 m^3/s with and without side weir.

c. To observe water levels along the side weir at Katragada for the above discharges.

d. With 300 m length of the proposed side weir, discharges in canal and water levels in river on upstream side of weir and in the pond, upstream of Head Regulator are to be measured.

e. To measure drop in water level in the Vansadhara river at 2 km downstream of proposed weir.

7.7.3 MODEL

A hydraulic scale model of Katragada side weir was constructed to a scale of H = 200 and V = 40 and the studies were conducted for determining flow pattern under pre and post side weir scenario.

7.7.4 CONCLUSIONS

(i) For low as well as high flow stages in Vansadhara river, flow conditions with and without side weir were almost similar.

(ii) Model studies indicated that for discharge equivalent to 150 m^3/s in the Vansadhara river, negligible discharge passed through the side weir. With discharge of 200 m^3/s and 400 m^3/s, in the river, the discharge passing over the side weir are 29 m^3/s and 145 m^3/s respectively.

(iii) Water levels on upstream of side weir varied from 70.48 to 71.00 m for discharge of 150 m^3/s to 400 m^3/s respectively.

(iv) The drop in water level at 2 km downstream of side weir was in the range of 0.2 m to 0.25 m for low flow stages in the post side weir scenario.

(v) A proper flare to the abutment walls of the side weir is required for streamlined/smooth entry of the flow towards side weir.

(vi) The alignment of the side weir needs to be shifted by 3^o.

7.8 MATHEMATICAL MODEL STUDIES FOR THE PROPOSED NERADI BARRAGE CONDUCTED BY CWPRS AS PER DIRECTION OF VWDT (TECHNICAL REPORT NO. 5098) AUGUST-2013

7.8.1 BACKGROUND

During the visit of Hon'ble Vansadhara Water Disputes Tribunal to CWPRS on 03.05.2013, it was observed that since the physical Model studies of Neradi Barrage were carried out in the year 2005, the Tribunal felt that fresh data should be provided to CWPRS for it to decide, if any changes are required in the Model studies done so far and it directed accordingly. The Tribunal further directed that fresh river cross sections on the agreed locations be carried out jointly by the two party-States under the overall guidance of Central Water Commission from 15th to 22nd May 2013. The up-to-date G&D data available with Central Water Commission should also be supplied to CWPRS, Pune for making comparison of the data and coming to a conclusion, whether any changes are required to be made in the Model studies.

7.8.2 SCOPE OF THE STUDY

a. To assess the extent of back water effect due to Proposed Neradi barrage with newly surveyed data.

b. The result of the model study will be compared with the result of past model study to decide on the extent of changes in river if any qualitatively.

7.8.3 METHODOLOGY

One dimensional Hydrological Engineering Centre – River Analysis System (HEC-RAS) mathematical model was used and the study was carried out based on the data provided by the State Governments of Andhra Pradesh and Odisha.

7.8.4 DISCUSSION AND CONCLUSIONS

(i) Back water length after construction of Neradi barrage would be of the order of 6 km upstream of the barrage for a discharge of 16990 m^3/s, which is same as the results obtained from the earlier physical model studies.

(ii) For a discharge of 16990 m^3/s, increase in water level at cross section No.2 (2 km upstream of the barrage) over the existing condition (pre-barrage condition) was 5 cm. But the studies conducted during 2005, the increase in water level was 72 cm over the existing condition.

(iii) Rise in water level for a discharge of 16990 m^3/s, at cross section No. 6 (6 km upstream of the barrage)is of the order of 1cm and is nil at cross section No.7. With the physical model study conducted earlier (year 2005), the rise in water level at 6 km was 16 cm and was nil at 7 km upstream of proposed barrage.

(iv) The results of all the studies conducted above, generally indicate that the back water effect extends upto 6 km. The results of the physical model studies conducted

adopting old cross-section data had also indicated the similar results, wherein the backwater effect had extended upto 6 km only. It appears, the rapids (standing wave) existing at 6 to 9 km upstream of proposed barrage are arresting the travel of back water wave at 6 km. It is evident from the results that the phenomenon of rapids formation existed earlier and is present now also. This shows that the river has not changed its regime over this period of time. However, small local changes like sedimentation at some place and erosion at other place has occurred, which are quite natural and are not so prominent to change final results already intimated vide physical model studies (Technical Report No 4212 of February 2005).

(v) HEC-RAS (Hydrologic Engineering Centre – River Analysis System) is one-dimensional model developed by United States Department of Defence, Army Corps of Engineers to manage rivers, harbours and other public works under their jurisdiction. The results of this software have been compared by many scientists and engineers with the prototype measured data and the same have been accepted and published in peer reviewed journals worldwide. Therefore, it has found wide acceptance by many others since its public release in the year 1995. Considering these facts, the results obtained from the

HEC-RAS software in the present case are highly reliable and hence, physical model studies are not required for the further verification of results.

7.9 MATHEMATICAL MODEL STUDY CONDUCTED BY CWPRS TO ASSESS THE BACK WATER EFFECT OF PROPOSED NERADI BARRAGE ALONG WITH PROTECTION WALL ON THE LEFT BANK OF RIVER VANSADHARA (TECHNICAL REPORT NO. 5294) JUNE-2015

7.9.1 BACKGROUND

The Tribunal visited the CWPRS, Pune on 4th and 5th December, 2014 to discuss the issues related to the model studies carried out for Neradi barrage. During the presentation in CWPRS, it was pointed out that a study is required to be done by the CWPRS taking into consideration the proposed protection wall on the left bank upstream of Neradi Barrage. The Tribunal directed the Government of Odisha to submit the cross sections and alignment of the proposed protection wall. After receipt of the consent of the Government of Odisha and Andhra Pradesh on the proposed alignment of the protection wall, CWPRS will carry out their study and give a report to the Tribunal and a copy thereof to both the States.

7.9.2 SCOPE OF STUDY

The back water length due to construction of proposed Neradi barrage would be assessed incorporating the alignment and details of proposed protection wall along the left bank.

7.9.3 MATHEMATICAL MODEL STUDIES WITH BARRAGE AND PROTECTION WALL

The 1-Dimensional mathematical model (HEC-RAS) study was carried out using the data provided by the project authorities considering upstream protection wall and the results compared with the existing condition (without barrage and without protection wall).

7.9.4 DISCUSSIONS

a. Theoretically speaking, the back water curve extends indefinitely in the upstream direction; hence, it has no upstream end point. For practical purposes, however, the end point may be selected at the place where the rise in water surface begins to cause damage. This can be assumed at a place where the depth of the flow is equal to a certain fraction of the normal flow depth, depending on the nature of the problem, say about 1% higher than the normal depth. In addition, the afflux ranging up to 10 cm could be considered negligible, as practically accurate measurements to that extent are hardly possible during the floods. The waves/local disturbances of more than this value are generally seen to occur in the river. The normal depth of flow is ranging from 7 to 10 m in the reach under consideration for River Vamsadhara for a discharge of 16990 m^3/s, 1% of this is 7 to 10 cm.

Considering the above fact, it is assumed that an afflux of 10 cm or below could be considered negligible in the present case.

b. The safety of flood plain beyond protection wall during the flood is not assessed in these studies. The project authorities are advised to properly assess this issue. However, while isolating the area on the left bank by the provision of protection wall, additional area on upstream is getting submerged on both the banks because of the higher afflux on upstream beyond 3.3 km long protection wall.

7.9.5 CONCLUSIONS

Based on the 1-Dimentional mathematical model studies conducted with pre-monsoon 2013 cross section data of river Vansadhara and with the provision of protection wall as per the agreed alignment of the wall submitted by the project authorities, CWPRS made conclusions, out of which the relevant ones are as follows:

(i) With the provision of barrage and protection wall, the maximum afflux is expected to be 211 cm at 4 km upstream of barrage for the calibrated varying ‘n’ values. This afflux value is expected to vary between 199 cm to 217 cm due to variation of ‘n’ in the range of ±30% from calibrated ‘n’ values. The afflux is computed to be lesser than 10 cm at a distance of 9 to 10 km upstream of the proposed barrage.

(ii) With the adoption of Manning's 'n' values of 0.03 for well defined sandy portion of river channel and 0.04 for over banks, maximum afflux was 95 cm at 4 km, diminished to 6 cm (less than 1% of normal depth) at 7 km and was zero at 12 km upstream of the proposed barrage.

(iii) The maximum afflux values of 126 cm, 104 cm and 108 cm are computed at 4 km for fixed 'n' values of 0.015, 0.030 and 0.045 respectively. The afflux in these cases is considered to be negligible (<10 cm) at 6 km, 7 km and 7 km respectively.

(iv) Considering results of all the cases, with the assumption of afflux less than 10 cm as negligible, the back water effect is expected to extend upto 9 to 10 km upstream of the proposed barrage.

(v) The project authorities are advised to assess the safety of the flood plain beyond protection wall on left flood bank, as it is about 4 to 6 m below the HFL during high flood corresponding to peak flood discharge of 16990 m^3/s.

(vi) Additional area on both the banks will be subjected to submergence for river sections beyond 3.3 km due to increased afflux caused mainly due to the provision of protective wall.

7.10 AREAS OF RESERVATIONS OF GOVERNMENT OF ODISHA TO VARIOUS STUDIES CARRIED OUT BY CWC AND CWPRS

7.10.1 RESERVATIONS OF GOVERNMENT OF ODISHA TO THE STUDIES DONE BY CWC:

A. Government of Odisha had certain reservations about the Mathematical Model studies carried out by CWC. Their main reservation was regarding the value of 'n' adopted by CWC.

B. CWC accordingly revised the analysis taking different 'n' values and also based on the additional cross-sections of the Vansadhara River provided by the State Governments of Odisha and Andhra Pradesh. The final report was submitted by CWC to the concerned State Governments in April, 2000.

7.10.2 RESERVATIONS OF GOVERNMENT OF ODISHA TO THE STUDIES DONE BY CWPRS:

A. Government of Odisha raised the issue of non-provision of protection wall in the model as also not using agreed 'n' value.

B. The above reservations were again raised by the representatives of Odisha during the visit of the Tribunal to CWPRS on 4-5 December, 2014 and were addressed by CWPRS in the Power Point presentation made by them. CWPRS, Pune communicated the clarifications to the reservations of Government of Odisha through their letter dated 15th December 2014.

7.10.3 CLARIFICATIONS BY CWPRS TO THE RESERVATIONS:

The clarifications communicated by CWPRS to the reservations of Government of Odisha are summarized below:

(i) On the query raised by Odisha whether flood protection works were considered in the 2013 mathematical model studies, CWPRS clarified that the mathematical model studies conducted in 2013 were undertaken with specific objective to establish whether there has been any major change in the river configuration when compared with the old river data of 2003. The river cross-section submitted by the State Government did not include the proposed embankment or flood protection. It may be mentioned that this aspect was not included in the predefined aim of the studies and no query in this regard was raised before the conduct of the studies. The mathematical model study was done to assess the effect of the natural changes that might have occurred over the period between the cross sections corresponding to old survey and survey conducted in 2013.

(ii) Odisha further raised the query that when the comparison of the Cross sections of 2003 and 2013 was not possible then how the results were comparable. The CWPRS clarified that the comparison of the river cross sections of 2003 and 2013 was not possible as the

cross section alignment and zero (starting point) were different in two surveys. Engineers of both the States accepted this flaw in the conduct of the survey and expressed that the reconciliation of new cross sections in relation to the old cross sections (2003) of Vansadhara river could not be done without proper expertise and neither CWPRS was having such expertise. In view of this, CWPRS suggested an indirect method of comparing the results by undertaking 1-Dimensional mathematical model studies utilizing the river cross section survey data of 2013 and with proper calibration of the model. Thus instead of establishing the physical changes in the river cross section the changes in the hydrodynamics, that may be major or minor could be decided based on the variations in the results. The 1-Dimensional model HEC-RAS does not require the zero and the alignment of the cross sections. It creates topography of the river based on the consecutive given cross sections and the computations proceed from one cross-section to the next one using standard step method of backwater computation.

(iii) Odisha further raised the query why were agreed 'n' values of 0.03 for deep channel and 0.04 for flood plain not used? CWPRS clarified that the Manning's 'n' is a calibration parameter in a 1-D model. The

mathematical model was proved initially for the existing condition of the river i.e. by conducting studies using river cross-sections and not including the barrage. The agreed flood levels at individual cross-sections were matched, by changing the manning's 'n' values. These manning's 'n' values were used further for model simulations of the river including proposed barrage. The difference in water levels upstream of the barrage computed in these two cases is termed as the afflux at those cross-sections. It was further clarified that in the 1-Dimensional mathematical model specifying different 'n' values for main channel and flood banks is ultimately converted to a single value known as effective 'n' value. Whatever may be the combination of river width and flood plain widths, with 0.03 and 0.04 as the 'n' values for channel and overbanks respectively (as agreed), the effective 'n' value is bound to lie between 0.03 to 0.04.

(iv) Odisha further asked whether there was necessity of lowering the crest of barrage. The CWPRS clarified that the crest of the barrage is set at RL. 67.97 m. From the cross section at the barrage axis, it could be seen that the crest was already at the bed level and possibility of further lowering was difficult.

(v) Odisha further raised the query why sediment was not considered in the study. CWPRS clarified that the 1-D

mathematical model used for assessing the water levels does not include sediment transport simulations. The simulations have been carried out for the present scenario of the river cross sections, which is taken as representative of the river regime for the prevailing flood flow and sediment transport.

(vi) On query by Odisha why there was variation in the afflux, the CWPRS clarified that the variation in the afflux reported in the technical reports is mainly attributable to the variation in cross section data supplied for the conduct of the studies. The limited cross section data submitted earlier was not extending on either side up to the high banks beyond the high flood levels. Due to the limited data the mathematical model considering a vertical wall at the two side, thereby restricting the area of cross section of the flow. This restriction would artificially amplify the afflux conditions in the model simulations. However, during the conduct of 2013 survey, at the insistence of CWPRS the data was acquired up to the high banks on both banks of river. Due to the inclusion of entire cross section for the flood flow, there is reduction in the afflux.

(vii) This Tribunal also desired to know what would be the impact of removal of Shoal upstream of the barrage and its effect on the backwater. The CWPRS replied that the removal of shoal upstream of barrage in order

to increase the width of river or flow cross section would normally result in reduction in back water length. Quick model simulations undertaken on 4th December, 2014 using 2013 data revealed that the backwater effects are bound to extend up to 4 to 5 Km instead of 6 Km. The afflux at the barrage, however, remains unchanged. CWPRS further stated that the removal of shoal by deepening the channel is morphologically not a recommended solution. This may lead to head cut and bank erosion on upstream. The shoal would always rebuild itself during subsequent flood events.

(viii) On query of Odisha regarding the concept of Gravity wave, CWPRS clarified that the effect of gravity upon the state of flow is represented by a ratio of inertial force to gravity forces. This ratio is called the Froude number. In case of Vansadhara River, the flow velocities and in turn the Froude number at round 6 to 7 km is more than unity. The same was observed on the model to be super-critical (Rapids). In view of this, the effect of back water which travels upstream as a gravity wave is arrested by this kind of flow.

(ix) As regards siltation of barrages, CWPRS clarified that the alluvial reaches of the river, under normal circumstances carry sediments/silts whose concentration depends on the flow velocities. Whenever the flow velocities reduce, the

sediments/silt is deposited on the river bed. The shoal (island) formations are the examples of such phenomena. These shoals gets washed away when large floods with high velocity flows exert shearing stresses. The cohesive strength of shoal material along with the vegetation may oppose the flushing of shoal. Formation of shoals/siltation is generally observed to occur on upstream of most of the barrages. However, its size and shape are governed by the hydrology, slope, sediment concentration and plan form of the river. The size of such shoals attain equilibrium in a short period of 15 to 25 years. The size of such shoals does not increase infinitely and they attain equilibrium. The shoals that are formed in the vicinity of barrage upstream are required to be flushed/managed by passing discharge using proper gate operation scheduling.

(x) Regarding gate-regulation/operation of Barrage gates, CPWRS clarified that the shoals that form in the vicinity of the barrage of upstream, are managed by inducing high velocity flows adjacent to them by operating the barrage gates. The shoals experience higher shearing stresses due to higher velocity of flow. For management of siltation the gates are accordingly operated during high floods of flush the siltation. The

well managed barrages generally do this by studying the gate operation scheduled on a physical model.

(xi) Odisha during their presentation at CWPRS had claimed "*Average/deepest bed levels of new cross sections of old and new surveys are compared and concluded that there is no morphological change in the river Vansadhara in the said reach. This statement was contradictory to earlier one."* CWPRS clarified that they have not discussed anything about morphological issues in the Technical report No. 5098 of August 2013. However, it was concluded that the changes in bed form of river Vansadhara in the given river reach were minor which may not change the flow phenomena on a larger scale.

However, it is to be noted that although at one stage the State of Odisha officials expressed certain reservations regarding reports of CWC and CWPRS, but the said reservations were taken notice of and addressed and clarified consequently. During the course of final arguments, the counsel for Odisha relied upon the contents of these reports and took strong support from some of the observations made therein to buttress their submissions regarding their opposition to the constructions of proposed Neradi Barrage as also the proposed Side Weir, which are dealt with in extenso while analyzing the submissions in the light of the records and while recording our findings.

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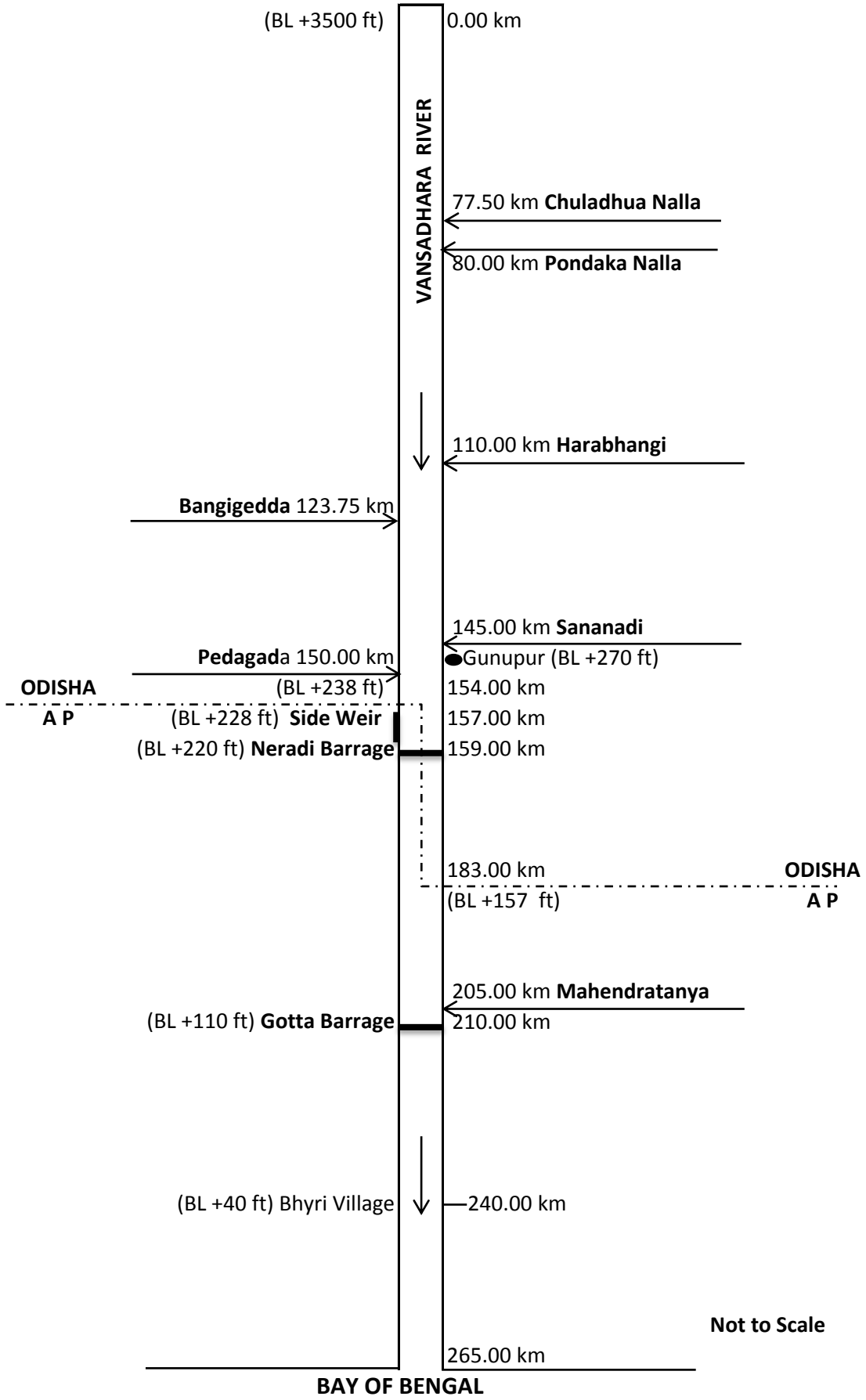
Annexure-I

LIST OF VILLAGES ON THE LEFT SIDE OF VANSADHARA RIVER IN ODISHA

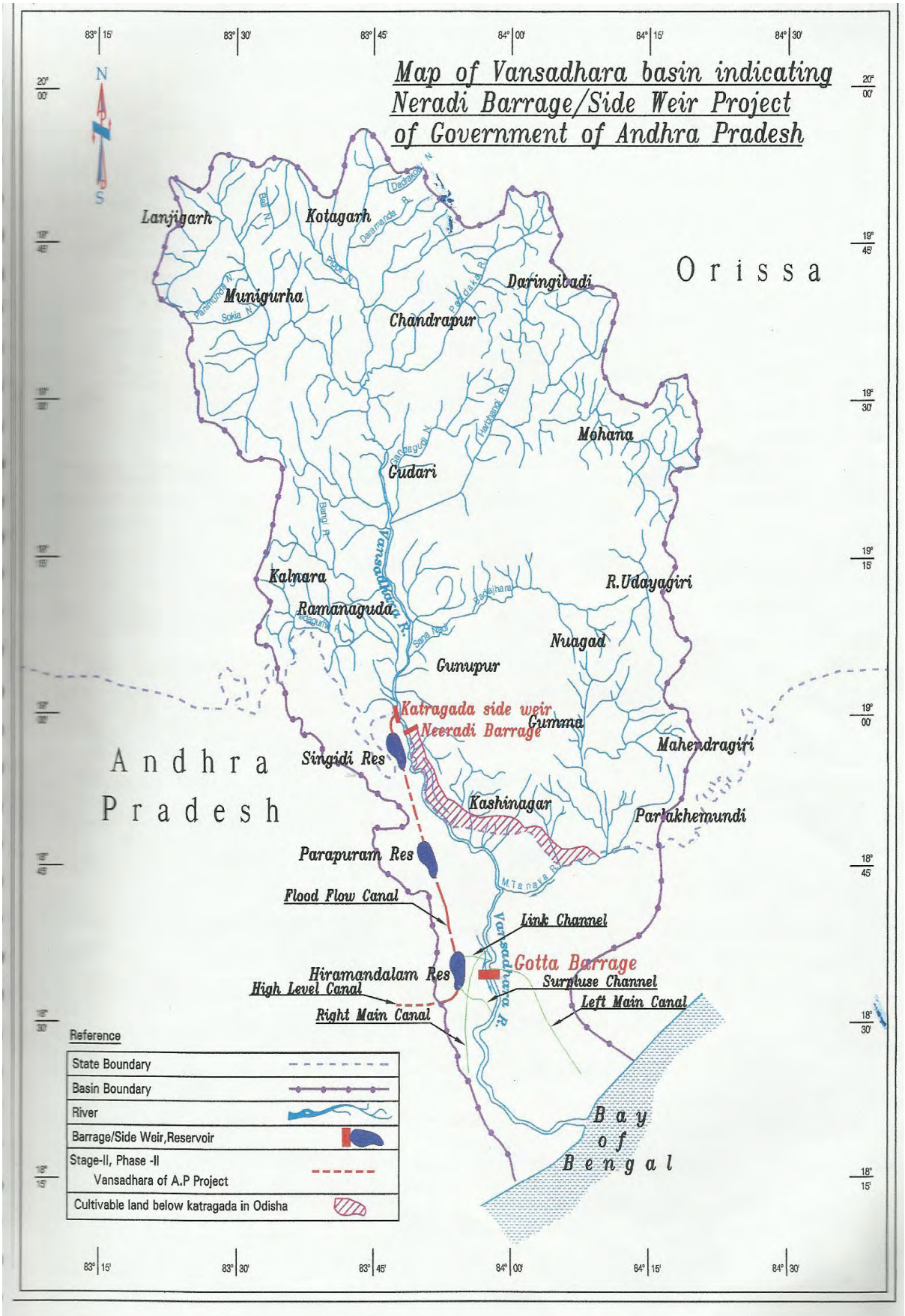
Sl. No.	Name of Village
1.	Sara
2.	Khandava
3.	Purutiguda
4.	Gouri
5.	Vanna
6.	Vannaguda
7.	Kitangi
8.	Batava
9.	Radhakrishnapur
10.	Bhupatilaxmipur
11.	Budura
12.	Idudi
13.	Khurigan
14.	Kashinagar
15.	KottaKashinagar
16.	Rajapur
17.	Kidigan
18.	Bhenkatapur

Annexure-2

SCHEMATIC MAP OF VANSADHARA RIVER



Annexure-3


Map of Vansadhara basin indicating
Neradi Barrage/Side Weir Project
of Government of Andhra Pradesh
Orissa
Andhra
Pradesh
Lanjigarh
Kotagarh
Munigurha
Chandrapur
Daringibadi
Mohana
Gudari
Kalnara
Ramanaguda
R.Udayagiri
Nuagad
Gunupur
Gumma
Mahendragiri
Singidi Res
Katragada side weir
Neeradi Barrage
Kashinagar
Parlakhemundi
Parapuram Res
Flood Flow Canal
Link Channel
Gotta Barrage
Surpluse Channel
Left Main Canal
Hiramandalam Res
High Level Canal
Right Main Canal
Vansadhara R.
Bay
of
Bengal
Reference
State Boundary
Basin Boundary
River
Barrage/Side Weir,Reservoir
Stage-II, Phase -II
Vansadhara of A.P Project
Cultivable land below katragada in Odisha